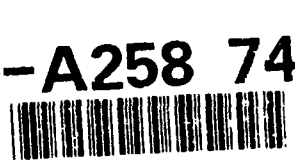

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REPORT NO T1-93

NUTRITION AND HYDRATION STATUS OF AIRCREW MEMBERS CONSUMING THE FOOD PACKET, SURVIVAL, GENERAL PURPOSE, IMPROVED DURING A SIMULATED SURVIVAL SCENARIO

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UNITED STATES ARMY
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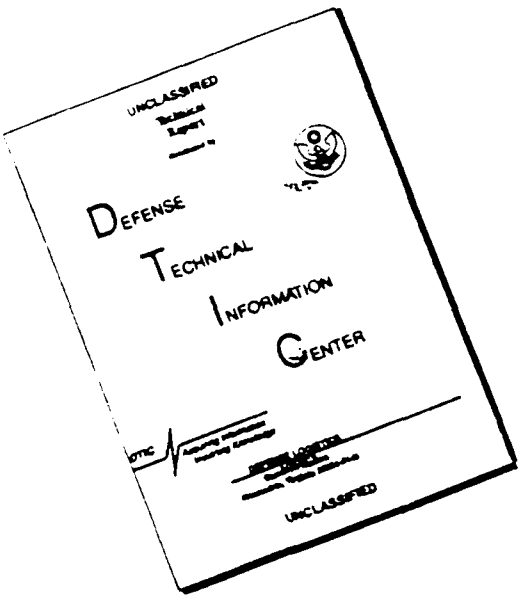

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Adequate nutrition and hydration can be crucial to the survival of downed aircrews. To determine the nutritional adequacy and palatability of an improved, all-purpose, all-environment survival packet (GP-I) compared to the old survival packet (GP), a field test was conducted using combat survival school students. During a five day survival exercise, 41 aircrew members ate the GP-I and 57 ate the GP . Nutrition/hydration status were assessed from food/fluid intake records as well as changes in body weight. Water turnover was measured in a subset of subjects (n=30) using deuterium oxide. Pre- and posttest hemoglobin, hematocrit, plasma osmolality, urine specific gravity (SG) and ketones were also measured. Acceptability of the two rations was evaluated. Subjects eating the GP-I consumed more Calories; GP-I 774±436 vs GP 642±408 kcal/d. Carbohydrate and protein consumption were similar but the GP-I group ate significantly more fat, 35±21 vs 24±18 g/d. Mean fluid intake was similar for both groups (GP-I 4.3±1.7, GP 4.4±1.9 L/d). Sodium intakes were 1.6 g/d. Weight decreased significantly for the GP-I and GP groups (2.9±1.4 , 3.4±1.7 kg, respectively); changes were similar between groups. Water turnover data indicated subjects maintained adequate hydration as did hemoglobin, hematocrit, and plasma osmolality. Mean posttest urine SG was 1.024±0.007 and moderate amounts of ketones were detected. Both rations received favorable ratings, but the greater variety of the GP-I ration resulted in higher acceptability ratings for this ration. We conclude from these results that either ration is adequate, however, the variety and palatability of the GP-I is more desirable than the GP.

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NUTRITION AND HYDRATION STATUS OF AIRCREW MEMBERS CONSUMING THE FOOD PACKET, SURVIVAL, GENERAL PURPOSE, IMPROVED DURING A SIMULATED SURVIVAL SCENARIO

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

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SUMMARY

An operational field test of the Food Packet, Survival, General Purpose, Improved (GP-I) prototype was requested by the Product Development Branch, Food Engineering Directorate, U.S. Army Natick Research, Development, and Engineering Center, Natick, MA. The development of this prototype was initiated in 1987 by the Air Force to replace the General Purpose Survival Packet (GP) which was type classified in 1961 and has components and packaging materials that are no longer available.

The test was done in June 1991 during the Field Training Exercise (FTX) portion of two consecutive classes of the U.S. Air Force Combat Survival School at Fairchild Air Force Base Spokane, WA. The course is designed to train aircrew members in the techniques of Survival, Evasion, Resistance, and Escape (SERE) procedures. Each class at the school lasts 17 days and trains an average of 100 personnel. Of the 17 days, the first week involves classroom instruction, days seven through 12 are a FTX, and days 13-17 concludes training with additional classroom instruction.

A total of 98 test volunteers were studied (87 males and 11 females). Baseline testing took place at the U.S. Air Force Survival School while the post-experiment testing took place in Colville National Forest, site of the FTX. Prior to deployment, subjects completed demographics and food frequency questionnaires. They were then instructed on how to accurately self-record daily food and fluid intake data and rate ration acceptance daily in a logbook. Instruction also included how to collect a first-void urine sample. Pre-experiment heights, body weights and urine samples were taken. Upon returning to the FTX base camp, post-experiment body weight was measured, logbooks were collected and verified and a urine sample was collected. Also a posttest questionnaire was administered soliciting ration acceptance and human factors information.

To better assess the subjects' hydration status, a subset of 30 volunteers was studied more extensively. In addition to the above measurements these subjects had the following procedures performed pre- and post-experiment: measurement of activity patterns using an activity monitor; estimation of percent body fat by the circumference method; determination of total body water and water turnover rate by administering the stable isotope deuterium oxide (^2H_2O); and venipuncture blood draw for hematology and chemistries.

The GP supplied 1131 kcal with 21 g protein (7% of the kcal), 46 g fat (37% of the kcal), 159 g carbohydrate (56% of the kcal), and 1.7 g sodium. The GP-I provided 1385 kcals consisting of 18 g protein (5% of the kcal), 65 g fat (42% of the kcal), 182 g of carbohydrate (53% of the kcal), and 2.4 g sodium. The GP group received four rations plus supplemental foods and the GP-I group received three rations plus supplemental foods to total approximately 989 kcal/d/person for the five-day study period. Subjects were also allowed to forage for food. Water was plentiful but needed to be purified.

Mean hours of inactivity averaged 6.3 hr/d for both the GP and GP-I groups. Also total daily energy expenditure for both groups was approximately 4700 kcal/d. The the GP-I group consumed more kilocalories; 642±408 kcal/d/person for the GP group and 774±436 kcal/d/person for the GP-I group. Mean protein and carbohydrate intake values were similar but fat intake was significantly greater for the GP-I group, 35±21 g/d versus 24±18 g/d for the GP group. Mean daily sodium intakes were approximately the same for both groups (1.6±2.2 g/d). Mean body weight (BW) losses were significant from baseline for both groups but not different between groups:3.4±1.7 kg (4.5% BW) for the GP group and 2.9±1.4 kg (3.8 % BW) for the GP-I group.

Mean fluid intakes were comparable for both groups: 4.4±1.9 L/d for the GP group and 4.3±1.7 L/d for the GP-I group. The mean post-study urine specific gravity was 1.024±0.007 for both the GP and GP-I groups. Hematocrit, hemoglobin, plasma protein, plasma osmolality, and water turnover data also were not significantly different between groups and showed that subjects were adequately hydrated. Both groups had small to moderate ketonemia post-study, consistent with caloric restriction.

Mood scores were similar for the two groups. Both the GP and GP-I received acceptable ratings in the field, but the improved variety of the GP-I resulted in higher acceptability ratings. The coffee packet was not used by the majority of test subjects due either to their concern over its diuretic properties or a dislike of coffee in general.

The results of this test show that both rations had similar effects on body weight loss and hydration status. The GP-I group consumed significantly more kilocalories (approx. 130 kcal/d) in the form of fat. The extra fat consumed during this short FTX probably moderated the body

weight loss but had little positive effect on either physiologic response or nutritional status of test personnel since short term energy deficits can be met by using body fat stores. Both rations received acceptable ratings; however, the variety of the GP-I proved to be a positive aspect of the new ration. As a consequence it is recommended that a variety of textures and tastes should be maintained in the bars and replacement of coffee with soup or some other hot or cold beverage powder should be considered.

INTRODUCTION

The primary purpose of this study was to conduct an operational field test and comparison of the Food Packet, Survival, General Purpose (GP) and Food Packet, Survival, General Purpose, Improved (GP-I) in a temperate environment. Data were collected on aircrew members' usual pre-study dietary practices, activity patterns, body composition, nutrition and hydration status, human factors and physical symptoms information, psychomotor performance and mood state, total menu and individual menu item acceptance.

FOOD PACKET, SURVIVAL, GENERAL PURPOSE BACKGROUND

The GP was type classified in 1961 and has been used in aircraft flight kits since that time. Due to small procurement quantities, the components of the packet are no longer being produced by industry. Similarly, the tin plate can is no longer readily available.

The GP components are individually packaged in cellophane material and contained in a tin can. The total size of the packet is 28 cubic inches and the weight is 341 g. The GP used in this test consisted of four 2" by 3" compressed bars: two cornflake bars, one granola bar, one rice/cornflake bar, instant coffee, sugar, and instant bouillon. It provided 1131 kcal with 21 g protein (7% of the kcal), 46 g fat (37% of the kcal), 159 g carbohydrate (56% of the kcal), and 1.7 g sodium.

FOOD PACKET, SURVIVAL, GENERAL PURPOSE, IMPROVED BACKGROUND

The development of the GP-I was initiated in 1987 by the Air Force. It was designed to replace the GP.

The requirements for the GP-I state that it must have a weight and size similar to the GP, that it can be used on land or sea for short periods of time (one to five days), that it provide an optimal nutritional content to conserve body water, prevent ketosis and that it be highly acceptable to help sustain morale. Survival packets are provided in aircraft, life rafts and in remote storage areas. Long term storage may be necessary, including periods of time at very high temperatures, such as would be found onboard an aircraft sitting on an asphalt runway

during the summer. Due to these potential logistic and environmental conditions, the storage requirement for this ration is five years at 80 °F and one month at 140 °F.

A review of existing military rations was conducted to determine if any components would be appropriate for use in the GP-I. The components had to be low volume, nutrient dense, low protein and high carbohydrate. Three of the bars in this ration were developed for other ration systems: the chocolate chip bar and cornflake cereal bar from the Ration, Lightweight-30 Day and the granola bar from the Ration, Cold Weather. Two bars were developed specifically for use in the GP-I: the shortbread bar and the wintergreen bar. To determine the shelf life of the ration, a long term storage study (five years at 80°F and one year at 100°F) is underway. Two years have been completed to date and the results indicate that all the components are acceptable.

The GP-I rations used for this FY91 test were produced and assembled at the U.S. Army Natick Research, Development and Engineering Center (USANRDEC), Natick, MA. All bars were evaluated microbiologically for safety and only generally recognized safe ingredients were used in their production. Since the completion of this field test, a Research and Development Production and Assembly test has been completed to determine the producibility of the ration by industry. Sixteen thousand cereal bars and 8000 of each of the other bars were produced by Sterling Food, Inc., San Antonio, Texas with little difficulty. Altogether 8000 rations have been assembled. These rations will be used for further evaluations and consumer testing. Future plans include the transition of the GP-I specifications to the Defense Personnel Support Center for procurement in FY 93.

The Committee on Military Nutrition Research (CMNR, the Committee) of the Food and Nutrition Board, Institute of Medicine, National Academy of Sciences was asked by the Military Nutrition Division of the U.S. Army Research Institute of Environmental Medicine (USARIEM) and USANRDEC to review the proposed nutrition standards for the Food Packet, Survival, General Purpose, Improved (originally New Generation Survival Ration) to determine if they were consistent with current scientific knowledge. After reviewing the scientific data available on survival rations they concluded that the criteria established in the early 1960's (1-3) are still valid (4). It was determined that conserving body water and preventing ketosis are of major importance in a survival situation. To conserve body water and prevent ketosis, the ration must provide adequate carbohydrate (at least 100 g), limited protein (less than 8% of the kcal), and restricted sodium (one to two g). Further, the Committee noted that in hot climates, when

adequate water is available, additional sodium is beneficial to help compensate for sweat loss. The committee has determined that the GP-I meets the nutritional requirements for a survival ration.

The GP-I components are individually packaged in a trilaminate material and contained in a paperboard box. The total size of the ration is 26.4 cubic inches and the weight is 332 g. The prototype GP-I used in this field evaluation consisted of five 1" by 3" compressed bars: two cornflake bars, one shortbread cookie bar, one chocolate chip bar, one granola bar, along with one package of hard candy (Charms), instant coffee, sugar and instant bouillon. The wintergreen bar developed for this ration was unavailable for use in this test; however, it will replace the hard candy in the future. The GP-I provides 1378 kcal and consists of 18 g protein (5% of the kcal), 65 g fat (42% of the kcal), 182 g of carbohydrate (53% of the kcal), and 2.4 g of sodium. Table 1 lists the kilocalories and grams of carbohydrate, protein, fat, and sodium content of the GP and GP-I rations. Also, weight and volume are shown for both rations. Nutrient composition data can be found in Appendix A.

Table 1. Nutrient composition, mass and volume GP vs GP-I

	GP	GP-I
Kilocalories	1131	1385
Protein (g)	21	18
Fat (g)	46	65
Carbohydrate (g)	159	182
Sodium (g)	1.7	2.3
Weight (g)	341	332
Volume (cu in)	27	26

FIGURE 1 Food Packet, Survival, General Purpose (GP)

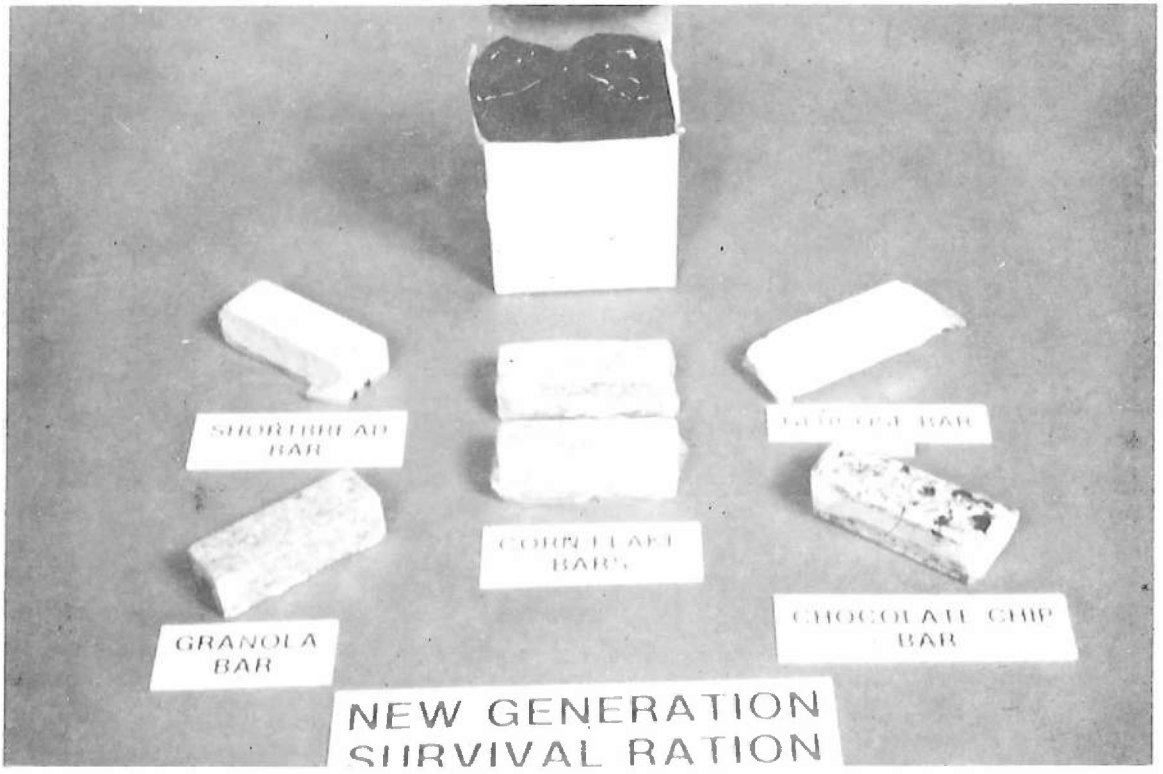


FIGURE 2 Food Packet, Survival, General Purpose, Improved (GP-I) (formally known as New Generation Survival Ration (NGSR))

OBJECTIVES

The effects of the ration and its acceptability were evaluated in 98 subjects over a five-day Field Training Exercise (FTX). During the study, volunteers consumed either the GP or GP-I. The overall objective was to determine if, during a short-term simulated emergency feeding scenario, with unlimited water available, the GP-I would adequately support five-days of moderate to heavy physical activity. The specific objectives of this study were:

1. Compare the nutritional adequacy of the GP and GP-I.

   a. Compare body composition changes that occur in aircrew members fed the GP and GP-I.

   b. Compare the hydration status of aircrew members fed the GP and GP-I.

   c. Compare deuterium oxide (^2H_2O) elimination estimates of water intake against logbook estimates of the water intake in active, aircrew members engaged in a FTX.

2. Compare the human, psychomotor and operational factors associated with consuming the GP and GP-I in a temperate environment.

3. Compare the acceptability and suitability of the GP and GP-I for use during a simulated survival situation.

METHODS

This ration study was a collaborative project of the U.S. Army Research Institute of Environmental Medicine (USARIEM) and the Food Engineering, and Soldier Science Directorates of the Natick Research, Development and Engineering Center (USANRDEC), Natick, MA. This study was approved by the USARIEM and U.S. Army Medical Research Development Command Office of the Surgeon General (USAMRDC/OTSG) Human Use Review Committees.

EXPERIMENTAL DESIGN

The study employed a prospective design. Pre-test assessments were made of usual dietary habits, body composition, urine and blood chemistries. During the FTX, weather, activity, food and fluid intakes, and mood were monitored. Posttest measures of weight, percent body fat, urine and blood chemistries, psychomotor performance and questionnaire follow up data were collected.

Table 2 shows the data collection schedule for the entire group and for the sub-set of 30 subjects who were studied more intensively. Baseline testing took place at the U.S. Air Force Survival School, Fairchild AFB, WA. The post-experiment testing took place in Colville National Forest.

Prior to the FTX deployment, subjects completed demographics and Health Habits and Diet Questionnaires (HHHQ). They were then instructed on how to accurately self-record daily food and fluid intake data and rate ration acceptance in a logbook. Instruction also included how to collect a first-void urine sample.

Pre-FTX height, body weight and a urine sample for specific gravity and ketone were taken. Upon returning to base camp post-FTX body weight was measured, logbooks were collected and verified and a urine sample was collected. Also a posttest questionnaire was administered soliciting acceptance and human factors information.

To better assess the subjects' hydration status, a subset of 30 volunteers was studied more extensively. In addition to the above measurements these subjects had the following procedures performed pre- and post-experiment: measurement of activity patterns using an activity monitor;

estimation of percent body fat by the circumference method; determination of total body water and its turnover rate by administering the stable isotope deuterium oxide (^2H_2O); venipuncture blood draw for hematology and chemistries; and a test of psychomotor performance.

Table 2. Data collection schedule

Procedures	Pre Study	Day 1	Day 2	Day 3	Day 4	Day 5	Post Study
Demographics questionnaire	X						
Prior activity level	X						
HHHQ	X						
Meteorological data		X	X	X	X	X	
Height	X						
Weight	X						X
Body fat %	X[1]						X[1]
Activity level	X[1]	X[1]	X[1]	X[1]	X[1]		
Food and water intake		X	X	X	X	X	
^2H_2O elimination method	X[1]						X[1]
Urine sample	X		X[1]				X
Blood sample	X[1]						X[1]
Psychomotor performance	X[1]						X[1]
Mood ratings		X	X	X	X	X	
Ration acceptability		X	X	X	X	X	
Final questionnaire							X[2]

[1]Completed by sub-group only
[2]Completed by everyone who consumed the test rations

TEST SUBJECTS

Test subjects were recruited from classes "91-36" and "91-37", U.S. Air Force Combat Survival Course Fairchild AFB, WA. Potential subjects were briefed on the nature of the study. Volunteers provided written acknowledgement of their consent (Appendix B). Students were already formed into two groups (A and B) prior to the beginning of the test. These groups were randomly assigned to eat one of the two test rations (GP or GP-I). All non-participating students ate the ration that their group was assigned. Thirty-eight students (51% volunteer rate) volunteered from class "91- 36" and 60 students (68% volunteer rate) volunteered from

class "91-37." Both males and females participated in the study. In the GP group 51 were male (89.5%) and 6 (10.5%) were female. The GP-I group was composed of 36 males (87.8%) and 5 females (12.2%). Subjects from the GP and GP-I ration groups were then randomly assigned into subgroups for more detailed study (Table 3).

TABLE 3. Total number of volunteers and ration group assignments

Ration group	Class "91-36"	Class "91-37"	Totals
GP ration	17	26	43
Subgroup GP	5	9	14
GP-I ration	7	18	25
Subgroup GP-I	9	7	16
Totals	38	60	**98**

OPERATIONAL SCENARIO

The study was held during the FTX of two consecutive classes of the U.S. Air Force Combat Survival School at Fairchild AFB in Spokane, WA from 13 June through 2 July 1991. The course is designed to "train aircrew members and other designated personnel in parachute descent procedures and employing principles, procedures, techniques, and equipment that enhance Survival, Evasion, Resistance, and Escape (SERE) prospects, regardless of climatic conditions or hostile environments. Its objective is to facilitate their return to friendly forces without rendering aid or comfort to an enemy, and with or without organized rescue and recovery (5)." Each class at the school lasts 17 days and trains an average of 100 personnel. Of the 17 days, the first week involves classroom instruction, days seven through 12 is a FTX, and days 13 to 17 concludes training with additional classroom instruction.

The classroom portions of the school were taught at Fairchild AFB and the FTX was held in Colville National Forest. The Colville National Forest is approximately 140 km (90 miles) north of Spokane. The elevation ranges from 762 m (2500 ft) to Calispell Peak which is approximately 2072 m (6800 ft). Even though the area is primarily a temperate zone forest, by 1371 m (4500 ft) it becomes subalpine (the area just below timberline). The steep, mountainous terrain of the forest has a floor covered with large amounts of varied debris, including many fallen trees, rocks, thick brush and undergrowth. The drainage areas are swampy and surrounded by dense vegetation.

Before each class started, the students were divided into elements (groups of 10 students with a leader). The first week was a classroom portion where students learned survival skills and evasion principles to be used operationally during the FTX. Since the purpose of the FTX was to practice these skills, students were restricted on what supplies and equipment that they could bring with them. They were allowed only the essentials (see "Student Required Equipment List (Summer)," Appendix C) and their rucksacks were checked by the instructors for non-essential items. Equipment shared by the element was divided amongst them to be carried, with each rucksack weighing 15-23 kg. They deployed for the FTX on the first day at 0800 via bus to Colville National Forest. Upon arrival to the drop off point, the students were briefed, broken up into groups of elements and headed out with an instructor to set up their initial campsite and fire circle.

Of the five nights of the FTX, each group spent the first three nights in a fixed campsite. Each day on the FTX was a 16-hour training day in which they learned most of the basic skills of survival to be used in both combat and noncombat situations and for use in all different types of climates and environments. These skills included (but were not limited to) sheltercraft; firecraft; survival medicine (hygiene, garbage disposal); adapting to the survival environment; care, use, and improvisation of clothing and equipment (using both man-made and/or natural materials, i.e. whittling eating utensils); water procurement, preparation, and preservation; food procurement, preparation, and preservation; signaling (for rescue); land navigation; and evasion training (evading the enemy). The first and second days were spent in static camps and training was done around the site. However, the third day the students were given points to find in order to practice land navigation after which they returned to camp. On these "out and backs" students carried all their gear.

On the fourth day of the FTX evasion exercise began. For this segment of the course, the students were divided into two-person teams, camouflaged, and given a number of compass headings and points to find. The instructors tried to "capture" them. Each night the students set up a different campsite while still in "combat mode." The evasion exercise continued throughout the fifth day and the morning of the sixth day. The FTX ended by noon on the sixth day with the end of evasion.

The physical activity level of the volunteers could be described as moderate to heavy. Both classes covered approximately the same distance daily except for day two when the second class walked two kilometers (km) less. The distances covered were cross-country (off-trail) in a four square mile area with the elevation ranging from 2500 to 4500 feet. Subjects were on

their feet for the entire 16 hour training day. The first couple of days were spent learning different survival techniques which required a fair amount of walking over hilly terrain without packs to identify edible plants, shelter sites, water sources, and other materials to be used for survival purposes. The total distance walked was approximately 3.5 km on the first day and 4 km on the second day. The third day was primarily for teaching land navigation. This meant not only learning while walking in a group but also some "out and backs" while carrying full packs (16 - 23 kg/person) in order to practice navigating and learning to walk on the varying terrain. The volunteers covered approximately 3 km carrying their backpacks. The last two days were devoted to the evasion exercise which required walking quickly with full packs and covering 2 km per day.

RATIONS

Table 4 lists the foods issued to both the test group (GP-I) and the control group (GP) for the five-day study period. Weight, kilocalories and total grams and percent of calories coming from protein, fat and carbohydrate are shown for both groups. Course requirements dictated that subjects receive foods that could be preserved and/or made into a stew (i.e. rabbit, steak, onion, and potato). Test volunteers also supplemented their diet with items they foraged. These included porcupine, snake, squirrel, trout, frog, venison, snail and numerous plant foods.

In order to give the survival school students the same amount of kilocalories they would have normally received, four GPs and three GP-Is were issued. This provided the GP group with 87 kcal/d more (7% extra) than the GP-I group. Issuing these extra kilocalories was unavoidable because it not feasible to break up individual ration packets.

Table 4. Total amount of food issued to each volunteer

	GP Group	GP-I Group
	4 GP rations 1 small potato 1/2 small onion 4 oz round steak 1/10, rabbit 1/10, 34 oz jar tang	3 GP-I rations 1 small potato 1/2 small onion 4 oz round steak 1/10, rabbit 1/10, 34 oz jar tang
Weight (g)	1160	1023
Kilocalories (kcal)	5391	5001
Protein	145g/11%	115g/9%
Fat	203g/34%	214g/39%
Carbohydrate	748g/56%	672g/54%
Supplemental foods totaled 867 kcal, 61 g protein, 19 g fat, 112 g CHO		

PROCEDURES

Demographics and Physical Activity Questionnaire

A demographics questionnaire was administered to all 98 subjects prior to the start of the study. It included questions on age, gender, time in service, primary MOS, education level, current unit assignment, position held in unit, and length of time in unit. Physical activity questions were also asked to determine the exercise habits of the subjects. These included questions on duration and intensity of running and exercise as well as classifications of job, physical fitness, and physical activity in comparison with peers.

Usual Dietary Intake and Health Habits

The long version of the Health Habits and History Questionnaire (HHHQ) produced by Block et. al. (6) for the National Cancer Institute (NCI) was used to assess the test subjects' usual dietary intake and smoking history (Appendix D). The questionnaire contains an open-ended food frequency section of 97 food categories that provides a semi-quantitative measurement over a one year period. Food frequency and portion size information for the questionnaire was obtained from the Second National Health and Nutrition Examination Survey (NHANES II) (7). The nutrient analysis is based on the USDA data base and the revised edition of Handbook No.

8 (6). The validity and reliability of the Health Habits and History Questionnaire have been substantiated by previous research (6,8-12).

The questionnaire was self-administered to 98 test subjects. Each subject received written instructions on how to accurately complete the questionnaire and was given two days to finish it. When the questionnaires were collected they were checked for proper completion.

The recommended guidelines by NCI for coding, validating and analyzing data were followed, and the NCI analysis software package was used for the dietary intake analysis of each subject. Contradictory data were flagged by the Diet Edit portion of the software program, and a subjects' data were dropped if the guideline of "too few foods consumed" or "too many foods skipped," was indicated which would have resulted in a deceptive nutrient intake.

Meteorological Measurements

Wet bulb globe temperature (WBGT) and dry bulb globe temperature (DBGT) were measured each day at 0530, 1300 and 2000 hours. The WBGT and DBGT meter was placed at a standard height of 4 ft above the ground.

Activity Patterns

Activity monitors (Actigraph, Ambulatory Monitoring, Inc., Ardsley, N.Y.) were used to identify periods of activity and inactivity during the five-day study period. Monitors were worn by nine subjects from the GP sub-group and 13 from the GP-I sub-group.

The monitor, a compact (6.4 x 8.9 x 1.9 cm), lightweight (90g) microprocessor-based unit, was attached to the non-dominant wrist of each subject. These monitors did not restrict the subjects' normal range of motion nor interfere with training activities. The activity monitors recorded motor activity in 1 minute epochs for the entire 5-day study period. The monitors were retrieved at the end of the study and the stored activity data down-loaded via an interface to a lap-top computer.

An algorithm for differentiating periods of inactivity and activity from wrist activity monitor data (13) was used to distinguish physical activity from inactivity,

$$S=(-0.001)A_{-5}+(-0.001)A_{-4}+(-0.001)A_{-3}+(-0.001)A_{-2}+(-0.003)A_{-1}+(0.007)A_{0}$$
$$+(-0.001)A_{1}+(-0.001)A_{2}\ 1.004.$$

The A_i's represent actigraphic measures for a completed minute epoch. Thus, A_{-3} is the measure for the one minute epoch completed 3 minutes ago. The activity/inactivity criterion is such that, if $S<0.5$, then A_0 is scored as active or if $S\geq 0.5$, then A_0 is scored as inactive.

Anthropometric Measurements

Height was self-reported for all subjects, except the sub-group who had their height measured in stocking feet standing on a flat surface with the head held horizontal. Body weight was measured pre- and post-experiment with foot and headgear removed and pockets empty using a calibrated, digital electronic, battery-powered scale accurate to ±0.05 kg (SECA Model 770, Hamburg, Germany). The clothing worn by each subject was noted and then those specific garments were weighed and subtracted from the airmen's recorded body weight. Body fat (energy store) changes were estimated on the sub-group according to the standard military method of taking circumference measurements (AR 600-9). Three measurements of the abdomen (level of the navel) and neck (below the larynx) were taken sequentially pre- and post-experiment by the same individual using a spring-loaded fiberglass anthropometric tape (Gulick Measuring Tape, Country Technology, Inc., Gays Mills, WI). Percent body fat was then calculated using a formula devised for the Army Weight Control Program (14). Female subjects did not have circumference measurements taken due to privacy constraints in the field.

Food, Water and Nutrient Intakes

Prior to deployment all subjects were issued pocket sized logbooks (approximately 14 x 10.5 cm) and instructed on how to accurately self-record their daily food and water intake. Airmen selected food items that they had just consumed and then circled the estimated portion size eaten (1/4, 1/2, 3/4, or 1). If they ate more than two of any item or less than one-fourth they were instructed to write down the amount consumed in a separate column. Subjects were also informed that no additional foods or beverages would be permitted in the field other than

those that were issued or could be foraged. Subjects were also instructed to write down all foraged food items and estimate, in household units, the amount eaten. The total amount of water drunk was recorded in one-quart amounts. Total water intake was estimated by summing the amount of water consumed from drinking and rehydrating food and beverage items and the moisture content of foods consumed. At the end of the study period, test subjects were interviewed by a trained dietary data collector to verify the accuracy and completeness of the recorded entries. Self-recorded food intake methods have been used in past ration tests and produced accurate results (15-16).

Nutrient intakes were calculated by factoring individual food items consumed against known macro- and micro-nutrient values (Appendix A). The nutrient factor file included nutrient composition values provided by USANRDEC (ration items) and the US Department of Agriculture Nutrient Data Base for Standard Reference (Handbook 8). Data reduction was done on a Digital Equipment Corporation Vax 780 computer using the Computerized Analysis of Nutrients (CAN) System developed by USARIEM (17). Nutrient intakes that are reported for this study include: kilocalories (kcal), protein (g), fat (g), carbohydrate (g) and sodium (mg). Since the survival ration is designed to be consumed for periods of less than five days nutrient standards for operational and restricted rations do not apply.

Intake Balance Energy Expenditure

Intake balance energy expenditure was calculated from metabolizable energy intake and the change in body fat (energy stores) during the field training exercise. Dietary energy intakes were calculated from daily food consumption records while changes in body energy stores were calculated from pre- to post-experiment changes in fat free mass (FFM) and fat mass (FM). Fat free mass was assumed to be 27 percent protein and 73 percent water, and fat mass was assumed to be 100 percent fat. The energy equivalents used for protein and fat were 4.4 and 9.5 kcal/g, respectively (18). Mean daily energy expenditure was calculated as the sum of metabolizable energy intake and the change in body energy stores.

Total Body Water And Water Turnover Rate

Measurement Of Total Water Influx By Deuterium Turnover. Deuterium oxide was administered orally (0.10 g/kg body mass; MSD Isotopes, St. Louis, MO) in the morning on day +1 and day +6. Deuterium space was calculated from deuterium enrichments in saliva before and three and four hours after dosing:

$$\text{Deuterium space} = (A/MW_d)(APE_d/100)\ 18.02\ [1/[R_{std}(E_s - E_p)]],$$

where A = dose in g, MW_d = molecular weight of dose water, APE_d = atom percent excess enrichment of dose water, $R_{std} = 2.005 \times 10^{-3}$, the ratio of heavy to light isotope of SMOW, and E_s and E_p = the per mil (‰) enrichments of the final and predose samples, respectively (19). The second determination of deuterium space was corrected for changes in baseline isotopic enrichment.

First-void urine samples were collected on days -2, +2 and +6 and used to monitor isotope elimination. Total water influx (r_{tl})(g/d) was calculated from deuterium turnover (k_H),: where $\bar{D}$ is the average of the initial and final deuterium dilution space (20).

$$r_{tl} = (\bar{D} \cdot k_H)$$

Isotopic Fractionation. Deuterium is lost via respiratory and cutaneous evaporation more slowly than is hydrogen (21-22). With no correction, the net effect of this isotopic fractionation results in an underestimate of total water influx. However, fractionation correction factors, which are calculated from the ratio of evaporative to non-evaporative water loss, are usually around 0.99 and may be used to reduce the impact of fractionation on the accuracy of water intake calculations (23). Absolute humidity was determined from wet and dry bulb temperature measurements made three times per day at approximately 0530, 1300, and 2000 hours, and was used in calculating fractionation correction factors (19). Median absolute humidities for weeks one and two were 8.94 and 10.55 mg/L, respectively. Water efflux in $g \cdot m^3$ was calculated from estimates of expired air volume and absolute humidity. Expired and inspired volumes were assumed to be equal; ventilation was calculated as previously described (20).

It was assumed that the clothing worn by the subjects covered 75 percent of their body and reduced the rate of evaporation through clothed areas by half from the 0.014 $g \cdot min^{-1} \cdot m^2$ rate of evaporation from bare skin at room temperature at rest (24). The net estimated rate of transcutaneous water efflux was 0.088 $g \cdot min^{-1} \cdot m^2$.

Water Influx and Food Consumption. Transcutaneous water influx in mg/min was calculated as 180 × (absolute humidity/21.7) × (body surface area), assuming a transcutaneous influx of 180 mg/m^2 body surface area/minute in adults in a saturated 24 °C atmosphere (25), median ambient absolute humidities of 8.94 and 10.55 mg/L, and a 37.5 percent reduction in transcutaneous water influx due to clothing. Respiratory water influx was calculated as pulmonary ventilation × absolute humidity.

Food consumption is described under the heading "Food, Water and Nutrient Intakes" on page 13.

Metabolic Water. Metabolic water was calculated from the water formed by the oxidation of protein (1 g protein = 0.41 g water), fat (1 g fat = 1.07 g water), and carbohydrate (1 g CHO = 0.60 g water) in foodstuffs and from changes in body energy stores (26). Fat-free mass was assumed to be 27 percent protein and 73 percent water. Dietary records, anthropometric estimates of the change in body energy stores, and energy expenditure estimated by the intake balance method, were used to calculate substrate oxidation and metabolic water production.

Specifically,

(1) protein oxidation in g = (dietary intake + (0.27 × ΔFFM)),

(2) fat oxidation in g = (dietary intake + ΔFM),

(3) carbohydrate oxidation in g = dietary intake,

(4) metabolic water production = (0.41 g H_2O × g protein oxidized) + (1.07 g H_2O × g fat oxidized) + (0.60 g H_2O × g carbohydrate).

Anthropometry. Anthropometrically determined changes in body energy stores were estimated from changes in body mass and skinfolds. Anthropometry is described under the heading "Anthropometric Measurements" on page 12.

Deuterium Analysis. The hydrogen isotope abundances were measured on a Finnigan Delta S gas-inlet Isotope Ratio Mass Spectrometer. Briefly, urine and saliva samples were distilled under vacuum into tubes containing zinc reagent (Friends of Biogeochemistry, Bloomington, IN). The reduction tube was sealed with a flame and placed in a 500°C oven for 30 minutes to reduce the water to hydrogen gas which was then introduced into the mass spectrometer.

The H_2 was isotopically analyzed against two working standards that had been calibrated against SMOW and Standard Light Arctic Precipitation (27). The results were expressed as the per mil difference from SMOW and corrected for 0.5 percent memory on the reduction system. The SD of a single analysis was 1.7×10^{-5} atom percent for urine and saliva. Each sample was analyzed in triplicate.

Isotope enrichments were calculated by taking the arithmetic difference between the per mil enrichment of each sample and the respective predose sample. The ratio of excess isotope is calculated and converted to atom percent excess (APE) (28).

Urine Chemistries

First-void morning urine samples were collected on all subjects pre- and post-experiment and on the sub-group on day two. Samples were collected in 50 cc screw top tubes and analyzed for specific gravity using a refractometer accurate to ±0.001 units (Atago, LTD, UR-1, Tokyo, Japan). Urine dipsticks (Ames N-Multistic, Miles Inc., Elkhar, IN) were used to estimate ketones. The ketone measured by this method is acetoacetate and the scale is calibrated in increments of 5, 15, 40, 80 and 160 mg/dL corresponding to trace, small, moderate, and large amounts of ketones, respectively.

Blood Chemistries

Pre- and post-experiment fasting blood samples were drawn on the sub-group by venipuncture, by an Air Force Independent Duty Medical Technician (IDMT) using standard aseptic techniques. Samples were taken from an antecubital vein and drawn into a serum vacutainer system without stasis. One (5cc) Ethylenediaminetetraacetic Acid (EDTA) tube was used for a whole blood sample and one (15cc) Serum Separator (SST) tube was used for a

serum sample. Hematocrit was determined by use of a heparinized capillary tube and read after spinning for five minutes on a micro hematocrit centrifuge (Model IEC/MB, Damon, Dunstable, England). The EDTA tube was then sent to Fairchild AFB Hospital where a complete blood count (CBC) was performed (Sysmex K1000, Baxter Inc., McGaw Park, IL). After the blood in the SST tube had clotted, the tubes were centrifuged and the serum poured into a 5 ml cryo tube for storage and shipment to Pennington Biomedical Research Center, Baton Rouge, LA for analysis. Glucose, blood urea nitrogen (BUN), creatinine, sodium, potassium, chloride, carbon dioxide, uric acid, total protein, albumin, calcium, phosphorus, magnesium, cholesterol, triglyceride, high density lipoprotein (HDL), low density lipoprotein (LDL), total bilirubin, lactic acid dehydrogenase (LD), creatine kinase (CK), and iron chemistries were performed on serum using an automated chemistry analyzer (Beckman Synchron CX5, Beckman Industries Inc., Fulerton, CA). Three 10 µL aliquotes were removed from the remaining serum and used to measure serum osmolality using a freezing point depression osmometer (Model 5004, Precision System Inc., Natick, MA).

Mood Ratings

Daily mood ratings of the subjects were determined using 100 millimeter visual analogue scales. Subjects placed a mark on the scale according to how much the statement deviated or agreed with their mood. Descriptors utilized for the two sub-groups of subjects who completed the performance tests included: alertness, sleepiness, effort, weariness, tension, calmness, happiness, sadness, overall feeling, hunger, fullness, and thirst. The rest of the subjects only rated hunger, fullness and thirst. Overall feeling was anchored with "very bad" on one end and "very good" on the other. On the scales, hunger, fullness and thirst were anchored with "not at all" at one end and on the other an appropriate superlative expression such as, "the hungriest I ever felt." The remainder of the descriptors were anchored with "very little" on one end and "very much" on the other. The subjects recorded their ratings three times each day, roughly around mealtimes in the morning, afternoon, and evening for the five days.

Ration Acceptability

Field Ratings. Daily food item acceptability for the GP and GP-I was determined using a nine-point hedonic scale in which 9 corresponded to "like extremely," 5 corresponded to "neither like nor dislike" and 1 corresponded to "dislike extremely (29)." The subjects rated each food item in the 5-day logbooks used to record food and water intake and mood.

Final Questionnaire Ratings. Two questionnaires (Appendix E), one for the GP group and one for the GP-I group, were developed by the USANRDEC and were administered on the last day of data collection. Both questionnaires contained similar questions assessing airmen's opinions of their respective rations in terms of acceptability and human factors issues, as well as collecting information on demographics and field conditions. Final questionnaires were administered to every student participating in the survival course who wished to fill out a questionnaire, regardless of whether they participated in the study.

Statistical Analysis

Two consecutive survival course classes were studied during a two-week period in June 1991. Thirty-eight students volunteered from class "91-36" and 60 students volunteered from class "91-37." Two-tailed unpaired Student's t-tests were performed on data from these two groups to determine if there were any significant differences between iterations. It was found that there were no significant differences between classes except in weight loss (-4.0±0.6 kg GP; -2.7±-.8 kg GP-I; Δ-1.3 kg). The class "91-36" mean body weight tended to be greater than that of class "91-37" (Δ3.0 kg); although this was not significant. In addition, class "91-36" walked slightly farther than class "91-37" (2 km per day more during the first two days) and had a slightly more active schedule. Given these few differences, the data from the two iterations were combined to simplify the presentation of the results.

One-way analysis of variance with repeated measures (BMDP2V 1990, BMDP Statistical Software Inc., Los Angeles, CA) was used to analyze ration and water intake data. Two-tailed Paried Student's t-tests were used to test for differences between pre- and post-measurements of individual subjects (SPSS-X 4.1, SPSS, Inc., Chicago, IL) for the demographics questionnaire, Health Habits and History Questionnaire, activity patterns, anthropometric measurements, urine chemistries, and blood chemistries.

The field acceptability and final questionnaire data were analyzed using SPSS/PC+ 4.1 (SPSS Inc., Chicago, IL). T-tests and analysis of variance tests (ANOVA's) were used to detect differences between groups and within groups over time.

The Dixton's test statistic was used to determine if a particular subject's water turnover data could be consisder an outlier (30).

All results are expressed as mean ± SD. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

SUBJECT CHARACTERISTICS

The demographics and physical activity questionnaire was completed by 54 (57 issued) of the GP subjects and 39 (41 issued) of the GP-I subjects. The number of students completing each question varied due to incomplete data on some of the questionnaires.

The GP and GP-I groups' initial physical characteristics are presented in Table 5. No significant differences were found between the groups in regard to age, height, initial body weight, or time in service.

Table 5. Physical characteristics of volunteers

Volunteer characteristics	GP	GP-I
n	57	41
Age (y)	25±4	26±5
Time in service (y)	4.3±3.8[1]	3.8±3.7[2]
Height (cm)	177±6	176±7
Initial body weight (kg)	76.1±10.7	76.7±9.5

The position held in unit was similar for both groups. The majority of the subjects in both groups was pilots (GP=24.6%; GP-I=31.7%). The second most common position held in the GP and GP-I groups was navigator accounting for 15.8 percent and 19.5 percent, respectively. Sixty-seven percent of the test subjects had obtained a four year college degree.

The questionnaire also queried subjects regarding physical activity prior to attending the survival school. No significant differences were found between the GP and GP-I groups for number of runs per week, minutes per run, number of exercise sessions per week and minutes per exercise session (other than running) (Table 6).

Table 6. Physical activity prior to study

Physical activity	GP	GP-I
n	54	39
Runs/week	2.1±1.6	1.8±1.6[1]
Minutes/run	18.8±17.1	18.5±18.3
Exercise sessions/week	2.8±1.8	2.6±2.0
Minutes/exercise session	54.4±37.8	67.7±51.3

[1]n=38

HEALTH HABITS AND HISTORY QUESTIONNAIRE

The HHHQ was administered to 98 subjects (57 GP and 41 GP-I subjects). Eighty-eight subjects completed the questionnaire, 50 from the GP ration group and 38 from the GP-I group, yielding a 90 percent recovery rate. Fourteen subjects, six GP and eight GP-I, were dropped due to insufficient reporting of calorie intake to maintain body weight. A total of 74 questionnaires, 44 GP (6 female) and 30 GP-I (4 female), were used in the final analysis of usual nutrient intake over a one year period.

Ninety-six percent of the GP subjects reported that they were not following a special diet, 2 percent reported following a weight loss diet, and 2 percent reported following a weight gain diet. None of the GP-I subjects reported following a special diet. Neither the GP or GP-I groups reported taking any vitamin and/or mineral supplements.

Twenty-seven percent of the GP ration group and 47 percent of the GP-I ration group reported no change in weight over the past year. A weight loss of over 5 lbs was reported by 26 percent of the GP ration subjects and 13 percent of the GP-I ration subjects. Three percent of the GP group and 30 percent of the GP-I group gained over 5 lbs. Thus some subjects reported they had both lost and gained weight over the past year.

Seventy-three percent of the GP subjects and 77 percent of the GP-I subjects were non-smokers.

Mean nutrient intakes and nutrient intakes as expressed as a percentage of the Military Recommended Allowances (MRDA) for both groups are shown in Table 7. The only significant differences in nutrients found between ration groups were total fat, saturated fat, oleic acid, and

linoleic acid intake. Both groups met the MRDA for kilocalories. The MRDAs for all the other nutrients were exceeded by both groups by 106 to 360 percent. Neither group reported taking vitamin supplements.

Table 7. Comparison of usual nutrient intake with MRDA

	MRDA[1]	GP	MRDA %	GP-I	MRDA %
n		44		30	
Kilocalories	2800-3600	2789±692	100	3138±1008	100
Protein, g	100	106±30	106	121±39	114
Fat, g		118±40	-	142±56	-
Carbohydrate, g	-[2]	316±93	-	329±117	-
Vitamin A, IU	5000	9882±4701	198	11229±6060	225
Vitamin C, mg	60	198±83	330	216±121	360
Thiamin, mg	1.6	1.9±0.7	119	2.1±0.7	131
Riboflavin, mg	1.9	2.7±1.2	142	2.8±1.0	147
Niacin, mg	21	27±8	129	30±11	143
Sodium, mg	-	4666±1543	-	5187±1994	-
Potassium, mg	-	4012±1195	-	4371±1424	-
Calcium, mg	800-1200	1141±549	114	1242±470	124
Phosphorus, mg	800-1200	1801±561	180	1995±587	200
Iron, mg	10-18	19±7	106	21±8	116
Cholesterol, mg	-	388±169	-	432±164	-
Saturated fat, g	-	43±16	-	52±20	-
Oleic acid, g	-	43±15	-	53±21	-
Linoleic acid, g	-	22±9	-	28±16	-
Fiber, g	-	18±6	-	20±16	-

[1]Military Recommended Dietary Allowances for males (17-50 years old)
[2]No specified MRDA

Table 8 shows the pre-test mean macro-nutrient composition for both groups. The carbohydrate percentages were below Army Regulation 40-25 (AR 40-25) recommendation of 50 to 55 percent kcal from carbohydrate while the percentage of fat was greater than the recommendation of less than or equal to 35 percent kcal (34).

Table 8. Comparison of pre-study macro nutrient composition with AR 40-25

	GP	GP-I	AR 40-25
Protein, %	15	15	*
Fat, %	38	41	≤35%
Carbohydrate, %	45	42	50-55%
Alcohol, %	1	2	*

* No specified MRDA

METEOROLOGICAL DATA

Temperature was recorded at approximately 0530, 1300 and 2000 hours each day. The mean daily wet bulb and dry bulb temperatures were 51±3 °F (10.6 °C) and 53±5 °F (11.7 °C) for classes "91-36" and "91-37", respectively. The relative humidity was 93±5 percent for both classes.

ACTIVITY PATTERNS

Actigraph data retrieval rates were 67 percent (6 valid, 9 issued, 3 failures) and 54 percent (7 valid, 13 issued, 6 failures) for the GP and GP-I groups, respectively. Data retrieval rates were not 100 percent due to Actigraph malfunction (7) and subject non-compliance (2).

The mean number of hours of inactivity for the GP group was 6.2±0.4 and ranged from 5.9±1.4 to 6.9±1.0 hours. The mean number of hours of inactivity for the GP-I group was 6.3±0.8 ranging from 5.0±0.5 to 7.0±0.4 hours. Means were not significantly different between groups.

ANTHROPOMETRIC CHANGES

Mean body weight changes are shown in Table 9. Both ration groups lost a significant amount of body weight (BW) (GP 4.5% BW and GP-I 3.8% BW). However, the difference in weight loss between ration groups was not significant.

Table 9. Weight change pre- to post-study

	GP	GP-I
n	57	41
Weight (kg), day 0	76.1±10.7	76.7±9.5
Weight (kg), day 6	72.7±9.9	73.8±8.7
Change	-3.4±1.7	-2.9±1.4

Difference in body fat loss between the GP and GP-I groups (Table 10). Two female volunteers included in both the GP and GP-I subgroups did not have their percent body fat taken because of privacy constraints in the field. These two female subjects tended not to lose as much weight as their male counterparts (-1.1 kg, vs -3.2 kg, respectively).

Table 10. Percent body fat change pre- to post-study

	GP	GP-I
n	13	15
Body fat (%), day 0	17.3±5.3	16.8±4.4
Body fat (%), day 6	15.4±5.3	15.5±4.5
Change	-1.9±1.3	-1.3±1.3

NUTRIENT AND WATER INTAKES

Eighty-one percent (46 retrieved, 57 issued) of logbooks given to the GP group and 91 percent (38 retrieved, 42 issued) of those given to the GP-I group were retrieved. Retrieval rates were not 100 percent due to the fording of streams and the extremely wet weather which destroyed some logs and the nature of the evasion and other exercises during which logs were lost.

Mean daily nutrient intakes of kilocalories, protein, fat and carbohydrate for each ration group are shown in Figures 3-6. Subjects consumed significantly more kilocalories on day 1 because they ate a garrison breakfast before departing for the field. Marcronutrient intake varied slightly from day to day, however no particular trend was detected.

Figure 3
Total Kilocalorie Intake

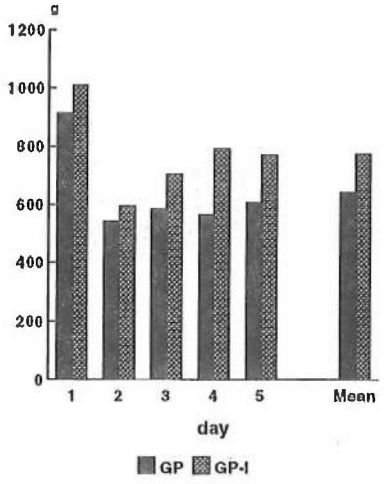


Figure 4
Total Protein Intake

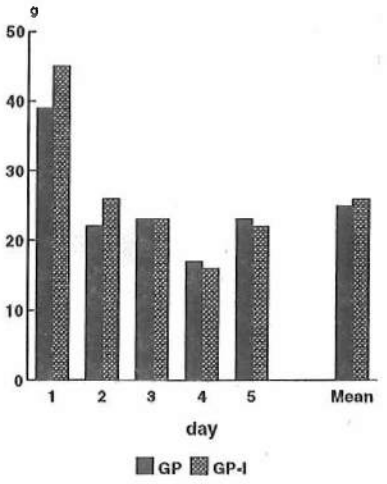


Figure 5
Total Fat Intake

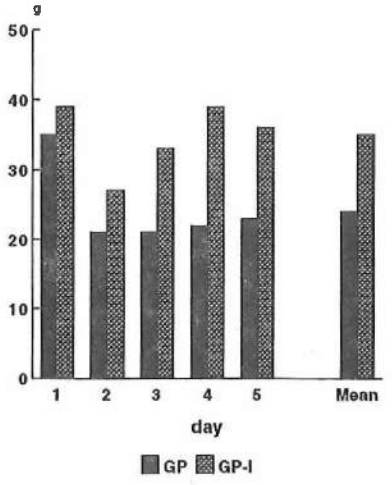
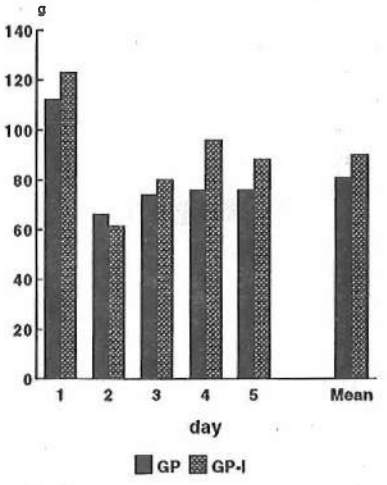


Figure 5
Total Carbohydrate Intake



The GP-I group consumed significantly more kilocalories than the GP group (Table 11). Mean daily protein intakes in grams were approximately the same for both groups (15.6% total kcal GP; 13.4% total kcal GP-I). Mean daily fat intakes in grams were significantly lower for the GP group compared to the GP-I and and accounted for a lower percent of total calories (33.6% vs 40.7%). Both groups consumed approximately the same amount of carbohydrate accounting for 49.8% total kcal GP; 46.5% total kcal GP, respectively.

Micronutrient fortification, except for sodium, is not done for these types of survival rations because of the short time periods of projected use. Mean daily sodium intakes were approximately the same for both the GP and GP-I groups (1.6±2.2 g/d).

Table 11. Mean daily nutrient intakes from all food sources

Nutrients	GP	GP-I
Kilocalories	642±408	774±436*
Protein, g	25±22	26±21
Fat, g	24±18	35±21*
Carbohydrate, g	80±54	90±57
Sodium, mg	1575±2587	1564±1814

* $P \leq 0.00$
Daily means were derived for each man and then man-means were averaged to get a group mean

Table 12 shows the distribution of kilocalories from the different food sources. Mean ration intake was significantly less for the GP group than for the GP-I group. The GP group consumed 48 percent of the rations issued while the GP-I group consumed 61 percent. Intake from supplemental and foraged foods were similar between groups.

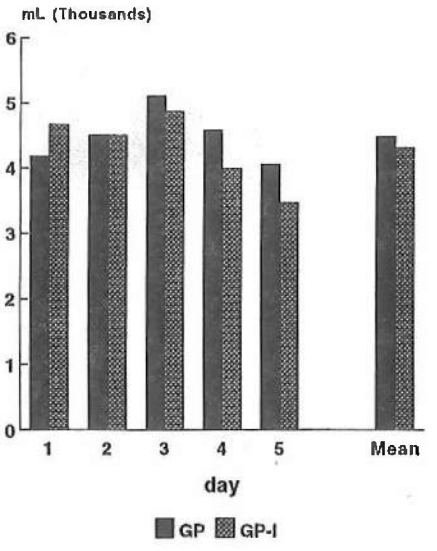
Table 12. Mean kcals consumed for entire five day period

Item	GP	GP-I
Breakfast, day 1	676±425	772±450
Ration	2151±877	2525±781*
Supplemental	462±227	500±225
Foraged	248±210	270±192
Mean 5 day total	3538	4067

*$P \leq 0.05$
Means were derived for each food type then summed

Both the GP and GP-I groups reported consuming approximately the same amount of water (4.4±1.9 L/d GP; 4.3±1.7 L/d GP-I). Water intakes did not vary greatly during the five-day study period as can be seen in Figure 7. There were no significant differences between ration groups.

Figure 7
Self-Reported Water Intake



ENERGY EXPENDITURE

Estimated energy expenditure using the intake balance method was 5351±2089 for the GP group and 4096±2113 for the GP-I group. There was no significant difference between groups. A combined energy expenditure for both groups (n=25) was 4697±2113 kcal/d.

TOTAL BODY WATER AND WATER TURNOVER RATE

Of the 30 subjects who were studied more intensively, 24 completed the entire D_2O sample collection schedule. In addition, one subject proved to be an outlier ($P \leq 0.05$) using the Dixon's test statistic (33). The mean elimination rate (kd) for D_2O was 0.10129±0.02989 for the GP group and 0.10189±0.01972 the GP-I group. Mean total body water did not change significantly pre- to post-experiment (Table 13).

Table 13. Total body water ($^2H^2O$ dilution) change pre- to post-study

	GP	GP-I
n	11	12
TBW day 0, kg	47.8±8.2	48.0±5.0
TBW day 6, kg	47.9±8.2	48.0±4.6
$p \leq 0.05$		

Water Influx

Total water influx which includes water from food and drink, water of oxidation, and water absorbed through the skin and lungs was 4946±1003 g/d for the GP group and 5092±836 g/d for the GP-I group (Tables 14 and 15). Mean respiratory water influx (r_{bl}) was about 5 percent and 3 percent of total water influx for the GP and GP-I groups, respectively. For both the GP and GP-I groups, mean transcutaneous water influx (r_{cl}) accounted for 4 percent of total influx while mean metabolic water influx (r_m) was about 12 percent and 8 percent, respectively. The sum of water influx from these three routes was 1102 g/d (21%) for the GP group and 824 g/d (16%) for the GP-I group. There were no significant differences between groups for any of these measures.

Table 14. Preformed water intake GP group (n=11)

Subject Number	Water Influx g/d	r_{bl} g/d	r_{cl} g/d	r_m g/d	Preformed Water g/d	Recorded Water g/d	Difference %
101	2959	242	195	629	1892	1939	2%
102	4329	178	210	483	3457	4488	30%
104	3973	100	221	280	3372	3753	10%
301	4924	372	229	870	3453	3622	5%
302	6508	440	231	1020	4817	3833	-20%
303	5359	121	275	279	4683	5066	6%
304	5796	342	226	801	4426	5037	12%
306	4281	264	234	625	3158	2605	-18%
307	5226	316	278	735	3897	5394	28%
308	5169	50	233	140	4747	4337	-9%
309	5886	252	246	615	4773	4193	-12%
Mean	4946	243	234	625	3880	4024	3%
SD	1003	122	25	288	920	1047	17

water influx = total water influx as calculated from deuterium turnover
r_{bl} = rate of respiratory water influx
r_{cl} = rate of transcutaneous atmospheric water influx
r_m = rate of metabolic water production
preformed water intake = (water influx - (r_{bl}+r_{cl}+r_m))

Table 15. Preformed water intake GP-I group (n=12)

Subject Number	Water Influx g/d	r_{bl} g/d	r_{cl} g/d	r_m g/d	Preformed Water g/d	Recorded Water g/d	Difference %
201	4138	150	216	398	3375	3450	2%
202	4146	209	190	562	3185	4778	33%
203	4509	151	223	400	3735	3199	-4%
205	5582	172	188	454	4768	5302	10%
206	5659	62	229	142	5226	3866	-26%
216	3522	111	192	296	2923	3805	23%
401	5376	286	256	666	4168	5609	26%
403	5532	251	246	600	4436	5466	19
404	6445	298	242	690	5215	5223	0%
407	5685	74	232	175	5204	3999	-23%
408	5204	177	224	420	4382	6117	28%
409	5304	115	219	268	4703	4562	-3%
Mean	5092	171	221	423	4277	4615	7%
SD	836	78	22	182	811	944	19

water influx = total water influx as calculated from deuterium turnover
r_{bl} = rate of respiratory water influx
r_{cl} = rate of transcutaneous atmospheric water influx
r_m = rate of metabolic water production
preformed water intake = (water influx - (r_{bl}+r_{cl}+r_m))

For the volunteer group as a whole total water influx was 5022±901 g/d. Respiratory and cutaneous water influx totaled about 8 percent, metabolic water contributed about 10 percent, and preformed water intake accounted for the balance. Subject's turnover rates were approximately 10.5% per day.

Preformed Water Intake

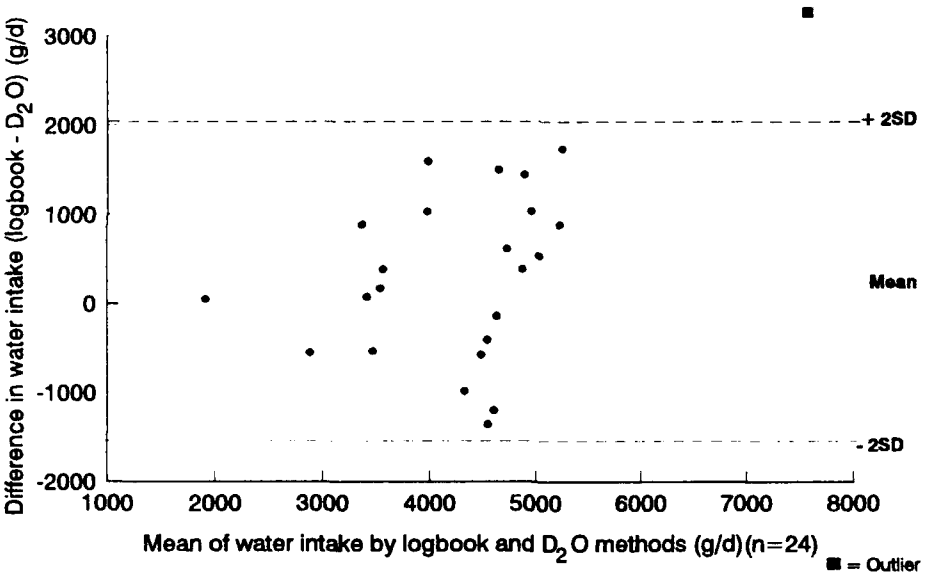
Preformed water intake (water intake from food and drink) was calculated from total water influx by subtracting the sum of respiratory water influx (r_{bl}), transcutaneous influx (r_{cl}) and metabolic water influx (r_m). There were no significant differences between groups (3880±920 g/d GP, 4277±811 g/d GP-I).

Comparison With Recorded Intake

For the group as a whole mean preformed water intake, calculated by the deuterium oxide method, and self-recorded water intake did not differ significantely (preformed 4088±867 g/d, recorded 4332±1017 g/d, difference 5±18%). The difference between the two methods plotted against the mean water intake by the two methods is shown in Figure 8. The overall mean difference between the two methods was 246±898 g/d. All values except for one fell within two standard deviations from the mean (-1550 to 2042 g/d).

Figure 8

WATER INTAKE BY LOGBOOK RECORD AND D_2O METHODS



URINE CHEMISTRIES

The urine sample retrieval rate was 92 percent (226 observations 19 missing values). These missing values were due to the unavailability of test subjects during the second iteration of post-study collection. The mean urine specific gravities (SG) pre- and post-experiment never

exceeded 1.030, however there were subjects who were above this criterion for hypohydration. Table 16 shows the number of individuals in each group who had urine SGs above 1.030. The mean urine SG prior to deployment was 1.022±.007 for the GP group and 1.021±.007 for the GP-I group. Mean post-study urine SG for the GP and GP-I groups were 1.024±0.006 and 1.024±0.007, respectively. There were no significant differences in urine SG between ration groups pre- to post-study.

Table 16. Frequency of urine SG > 1.030 per total observations

Urine specific gravity > 1.030	GP	GP-I
Pre-study	6/54 (11%)	3/41 (7%)
Post-study	12/53(23%)	12/30 (40%)
$p \leq 0.05$		

The frequency of ketones in the urine pre- and post-study are presented in Table 17. For the post-study urine sample the majority of subjects (100% GP and 97% GP-I) had small to moderate amounts of ketones compared to very few (2% and 7%) pre-test.

Table 17. Frequency of urinary ketones per total observations

Urine ketones	GP	GP-I
Pre-study	1/54 (2%)	3/41 (7%)
Post-study	53/53 (100%)	29/30 (97%)

BLOOD CHEMISTRIES

Comparisons of the pre- and post-study hemoglobin, hematocrit and serum osmolality values are shown in Table 18. All three measurements were within normal ranges before and after the FTX but did decrease significantly pre- to post-experiment. There were also significant differences between the GP and GP-I groups hemoglobin and hematocrit measurements pre-experiment.

Table 18. Pre- and post-study hemoglobin, hematocrit, and serum osmolality

		Hemoglobin		Hematocrit		Serum osmolality	
	n	Pre	Post	Pre	Post	Pre	Post
GP	14	15.6±0.8	14.7±1.1*	45.8±1.9	43.5±3.4*	290±7	279±6*
GP-I	16	16.3±0.7**	14.9±0.7*	47.5±1.6**	43.7±2.1*	292±6	276±4*

* P<0.05 pre- to post-experiment
** P<0.05 GP vs GP-I group

The results of the pre- and post-blood chemistries are shown in Table 19. Although there were significant differences in some pre- to post-measurements the majority of values fell within normal physiological ranges at both points. The exceptions were uric acid, bilirubin, creatine kinase (CK), lactic acid dehydrogenase (LD) and aspartate amino transferase (AST). There were no significant differences between ration groups

Table 19. Pre- and post-serum chemistries

	GP[1]		GP-I[2]		Normal Range
	Pre	Post	Pre	Post	
Glucose mg/dL	90±9	88±19	90±6	89±13	70-105
BUN, mg/dL	14±4	14±4	15±3	15±6	7-18
Creatinine, mg/dL	1.1±0.2	1.2±0.1	1.2±0.1	1.2±0.1	0.6-1.3
Sodium, mmol/L	142.4±3.6	137.4±3.4*	140.6±6.0	139.2±5.4	135-145
Chloride, mmol/L	106.0±2.7	101.7±3.8*	103.3±4.9	96.0±23.0	101-111
Potassium, mmol/L	4.12±0.29	4.41±0.73*	4.22±0.31	4.74±0.43*	3.60-5.00
CO_2	33.6±5.1	26.5±4.0*	31.4±8.3	30.1±4.1	21.0-31.0
Uric acid, mg/dL	5.9±1.0	9.1±2.1*	6.0±1.3	9.6±2.6*	2.6-7.2
Total protein, g/dL	7.7±0.4	7.8±0.6	7.5±0.3	7.7±0.5	6.7-8.2
Albumin, g/dL	5.0±0.2	5.2±0.5*	4.8±0.3	5.1±0.4	3.2-5.5
Calcium, mg/dL	10.5±0.4	10.2±0.6	10.3±0.4	10.3±0.6	8.4-10.2
Phosphate, mg/dL	4.8±0.2	3.0±0.4*	4.6±0.5	3.3±0.4*	2.5-4.6
Magnesium, mg/dL	2.3±0.2	2.0±0.2*	2.3±0.2	2.1±0.3	1.8-2.5
Bilirubin, T, mg/dL	0.9±0.2	1.5±0.6*	0.9±0.2	1.3±0.3*	0.2-1.0
CK, IU/L	205±197	887±414*	170±98	1359±827*	22-269
LD, IU/L	135±19	220±35*	134±26	267±74*	91-180
AST, IU/L	24±7	48±12*	23±7	58±18*	10-42
Iron, ug/dL	86±29	58±18*	97±36	68±22*	50-160

[1]n=14, [2]n=16
*p<0.05 pre- to post test differences

Blood lipid values are shown in Table 20. All mean values were within normal limits pre- to post-experiment but showed large significant decreases. Out of a total of 30 volunteers nine had pre-test values that were greater than 200 mg/dL (range 206 to 250 mg/dL) and an average cholesterol and HDL cholesterol risk ratio of 6.19 (range 4.58 to 8.59).

Table 20. Pre- and post-blood lipid values

	GP		GP-I		
	Pre	Post	Pre	Post	Normal
Cholesterol, mg/dL	183±32	165±28*	193±30	161±27*	140-200
Triglyceride, mg/dL	147±85	66±21*	127±52	69±22*	35-160
HDL, mg/dL	42±13	51±11*	44±8	47±10	30-70
LDL, mg/dL	112±27	102±29*	124±26	100±27*	65-175
CHOL/HDL ratio	4.36	3.23	4.39	3.43	4.97

* $P<0.05$

MOOD RATINGS

The mean daily mood ratings for each of the nine mood scales were calculated for each ration group and are presented in Figures 9-13. Overall, positive moods ratings tended to decrease over the course of the study, while the negative mood ratings tended to increase, showing a decline in the well-being of the students. These ratings corresponded to the rigors of the exercise. A MANOVA procedure with post-hoc comparisons showed that most mood ratings declined significantly while "effort," "weariness," "tenseness," and "sadness" were significantly higher on the last day than all the other days. The two ration groups were quite similar, as the only between group differences occurred for "sadness" and "effort" ratings on day one and day two. The reasons for these group differences were not clear.

Figure 9
Alertness and Sleepiness

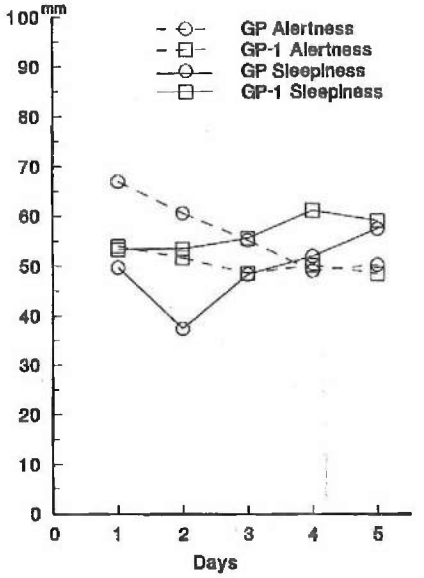


Figure 10
Effort and Weariness

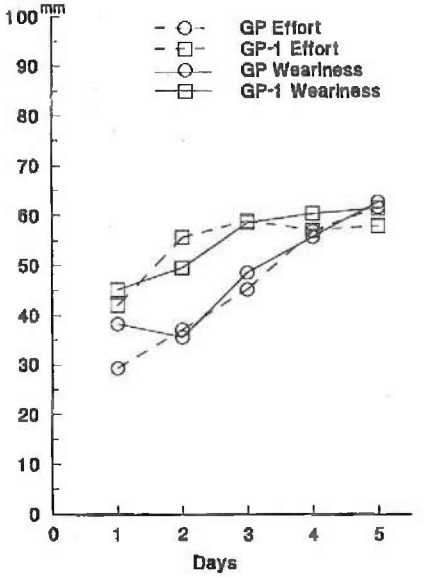


Figure 11
Tension and Calmness

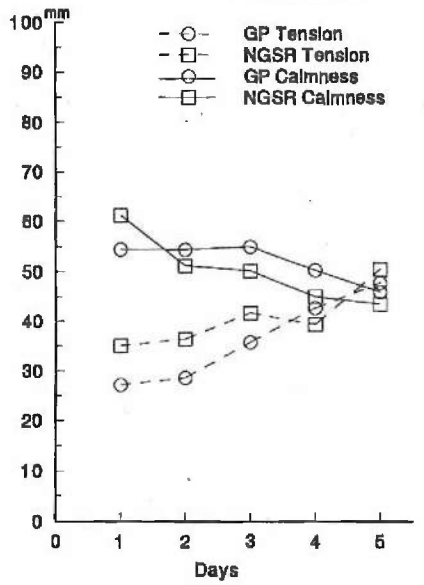
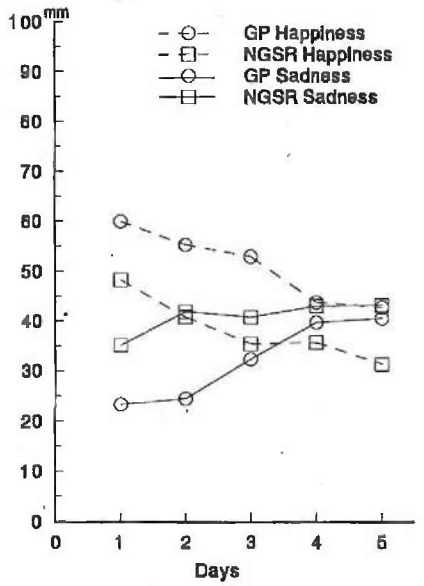


Figure 12
Happiness and Sadness



The mean daily mood ratings for hunger, fullness and thirst were also calculated for each group and are presented in Figures 13-15. Overall, hunger and thirst ratings tended to increase over the course of the study, while fullness ratings tended to decrease. A MANOVA procedure with post-hoc comparisons revealed that there were significant declines between the first day or two and the last day or two for fullness and thirst, while the hunger ratings for the first day were significantly lower than the ratings for the rest of the days. No significant between group differences were found.

Figure 13
Overall Feeling

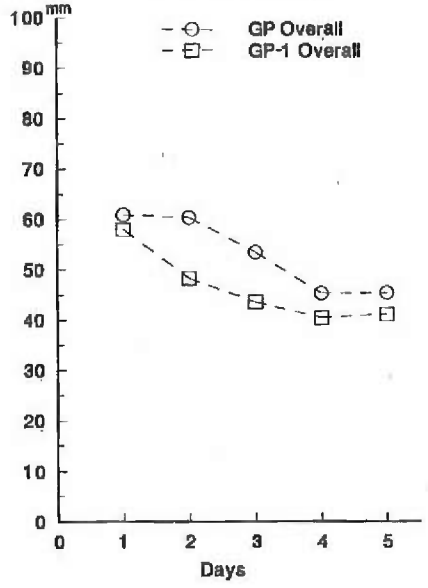


Figure 14
Hunger and Fullness

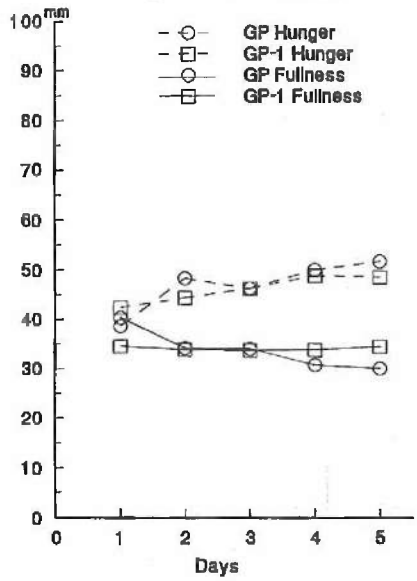
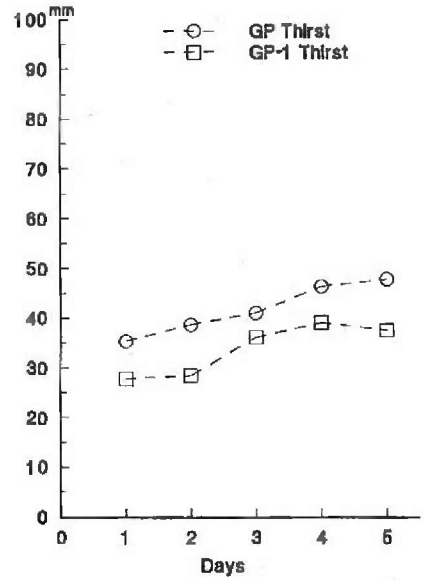


Figure 15
Thirst



RATION ACCEPTABILITY

Field Ratings

Field ratings for individual foods in the GP and the GP-I rations are presented in Table 21. The airmen were asked to rate each food item on a 9-point hedonic scale where 1 corresponded to "dislike extremely," 5 corresponded to "neutral" and 9 corresponded to "like extremely." Overall, the GP received ratings of "like slightly" or better. The Cornflake and Rice Bar received the lowest rating at 6.0, while the other bars received mean ratings of 6.2. Coffee received the highest rating at 7.5 (between "like moderately" and "like very much") but only six people drank it. The Soup and Gravy Base was also well received with a rating of 7.3.

Table 21. Mean individual food item field ratings

Item	GP	n	GP-I	n
Granola bar	6.2±1.7	6	7.1±1.3	30
Cornflake bar	6.2±1.3	40	-	-
Improved cornflake bar	-	-	6.5±1.8	37
Cornflake and rice bar	6.0±1.6	34		
Shortbread bar			7.3±1.3	34
Charms candy			7.4±1.3	27
Chocolate chip bar			7.0±1.8	30
Coffee	7.5±0.8	6	4.9±3.1*	11
Sugar	7.4±1.3	22	6.9±2.4	7
Soup and gravy base	7.3±1.3	20	7.3±1.9	16

n = Number of students consuming food item
* $P<0.05$

Overall, the GP-I received ratings of "like moderately" or better, except for coffee even though the type of coffee was identical in both rations. Charms candy was the most popular item in the ration with a mean rating of 7.4 or "like moderately." The bars otherwise ranged from 6.5 for the Improved Cornflake Bar to 7.3 for the Shortbread Bar. Coffee was the lowest rated item, receiving a mean rating of 4.9. Sugar at 6.9 and Soup and Gravy Base at 7.3 were both well received.

For items present in both rations there were no significant differences between ration item ratings, except for Coffee. The GP Coffee was rated significantly higher than the GP-I Coffee even though the coffees were identical.

Final Questionnaire Acceptability Ratings

On the final questionnaire, the subjects were also asked to rate each of the food items in the rations. In all cases, the ratings from the final questionnaire were lower than the field ratings. Table 22 summarizes the final questionnaire results. The Granola Bar and the Improved Cornflake Bar were rated significantly higher by the GP-I group and Coffee was rated higher by the GP group. The GP ratings ranged from 4.3 or "dislike slightly" for both the Cornflake type bars to 7.0 or "like moderately" for Sugar. The GP group ratings for the

Cornflake Bar and the Cornflake and Rice Bar were very similar. In the GP-I, ratings ranged from 4.4 or "dislike slightly" for Coffee to 7.2 or "like moderately" for the Soup and Gravy Base. There were many positive comments about the Soup and Gravy Base on the final questionnaire. However, many students on the final questionnaire expressed concern about including coffee in the ration. They indicated many of the students dislike or do not drink coffee and many were concerned about its diuretic effects.

Table 22. Mean individual food item final questionnaire ratings

Item	GP	n	GP-I	n
Granola bar	3.0±3.5	3	6.7±1.8*	69
Cornflake bar	4.3±2.3	57	5.6±2.0*	68
Cornflake and rice bar	4.3±2.3	49		
Shortbread bar			6.6±1.7	67
Charms candy			7.0±1.7	67
Chocolate chip bar			6.8±2.1	68
Coffee	6.0±2.0	28	4.4±2.5†	29
Sugar	7.0±2.0	46	6.4±2.0	30
Soup and gravy base	6.8±1.8	48	7.2±1.8	52

* $P<0.05$
† $P<0.01$

Final Questionnaire: Overall Acceptability and Human Factors

Sixty-four students who consumed the GP ration filled out final questionnaires, while 69 students who consumed the GP-I ration filled out final questionnaires. Table 23 contains summary ratings of overall acceptability, amount of food, variety, taste and appearance of the GP and the GP-I from the final questionnaire. The results show that on a 9-point scale, where 9 corresponded to "extremely satisfied," 5 was "neutral" and 1 corresponded to "extremely dissatisfied," the GP-I was rated significantly ($p<0.01$) higher than the GP for all aspects. The ratings for the GP and the GP-I ranged from 2.3 corresponding to "very dissatisfied" to 6.9 corresponding to "somewhat satisfied."

Table 23. Comparison of GP and GP-I characteristics

Characteristics	GP	n	GP-I	n
Overall acceptability	4.9±1.9	63	6.9±1.5*	69
Amount of food	4.4±1.9	61	5.5±2.4*	65
Variety	2.3±1.6	61	6.4±1.9*	66
Taste	4.2±2.0	62	6.4±1.9*	66
Appearance	4.4±1.8	61	6.1±1.9*	66

* $P<0.01$

On average, the GP group consumed two food bars a day, while the GP-I group consumed three bars a day. Both groups managed to make their bars last about 4.5 days. They ate their bars either throughout the day as time permitted or at specified mealtimes by their own choice. The GP group thought that all of their bars were "somewhat hard," while in the GP-I group the Cornflake Bar was reported to be "somewhat hard," while the remainder of the items were "just right." The GP group "sometimes" had problems with the bars being crumbly and falling out of the package, while the GP-I group "almost never" had these problems. For each item in the GP ration, 40 to 43.9 percent reported getting tired of chewing the bars, while in the GP-I group only 3.2 to 15.9 percent reported this. Again, this was probably due to the lack of variety in the GP ration and the texture of the available bars.

When asked to rate how hungry they were during the exercise, both groups reported that they were hungry "fairly often," with ratings of 3.6 ± 15 for the GP group and 3.4 ± 14 for the GP-I group on a six point scale (1 = Never and 6 = Always). Sixteen percent of the GP group and 25 percent of the GP-I group felt that they ate enough during the exercise. This makes sense because the GP-I group ingested a higher number of calories than the GP group due to the higher number of calories available in the GP-I. There was no difference between the groups in the amount of calories ingested from foraged items. Frequent reasons for not eating enough in the GP group included (students checked all reasons which applied): 57.8 percent got bored with the ration, 40.6 percent disliked the food, 23.4 percent reported that their bars were broken into crumbs and 17.2 percent got tired of chewing the ration. Reasons for not eating in the GP-I group included: 26.1 percent thought not enough food was provided in the ration, 17.4 percent did not feel hungry and 15.9 percent got bored with the food.

When asked about how easy it was to prepare the ration for consumption, both groups reported being "moderately satisfied" on a 9-point scale. Both groups also reported that the rations were "moderately easy" to "very easy" to use overall. However, both groups indicated that the instructions were "not at all helpful." It is apparent from the final questionnaires that many of the subjects either never had instructions with their rations or lost the instructions before they could read them. The GP group was significantly less satisfied with how easy the ration was to pack and carry than the GP-I group but still was "somewhat satisfied" on a 9-point scale. The ability to eat some of a bar and rewrap it in the trilaminate foil package for the GP-I ration was appreciated by most, others felt the trilaminate foil represented trash that had to be carried out and could not be burned to avoid leaving evidence in cases of evasion from an enemy. No other significant problems were reported with either ration.

Symptoms of Gastrointestinal Illness

On the final questionnaire, the subjects were asked to rate physical symptoms during the five-day test period based on how they typically felt. Table 24 summarizes these data. A chi-square analysis was run and no significant differences were found between the groups. Both groups reported that their appetite was less than usual and 49 percent of the GP group and 36 percent of the GP-I group reported feeling more constipated than usual.

Table 24. Frequency of physical symptoms experienced

		Frequency of Symptoms*		
Symptoms	Group	%Less	%Same	%More
Cramps/gas	GP[1]	29.5	57.4	13.1
	GP-I[2]	22.6	56.5	21.0
Nausea/vomiting	GP[1]	14.8	55.7	29.5
	GP-I[1]	18.0	68.9	13.1
Diarrhea	GP[1]	32.8	54.1	13.1
	GP-I[2]	33.9	56.5	9.7
Constipation	GP[1]	13.1	37.7	49.2
	GP-I[2]	11.3	53.2	35.5
Acid stomach	GP[3]	18.3	68.3	13.4
	GP-I[1]	18.0	62.3	19.7
Appetite	GP[1]	49.2	19.7	31.2
	GP-I[2]	35.5	30.7	33.9

* Percentages are from those who answered the question
[1] n=61, [2] n=62, [3] n=60

Self-reported Activity Level

On the final questionnaire, the subjects were asked to describe their level of activity during the training exercise. The results are summarized in Table 25. Both groups reported experiencing heavy daily physical activity, and there was no significant difference between the groups.

Table 25. Self-reported activity level

Daily physical activity	GP	GP-I
Heavy	79.9%	75.4%
Moderate	9.4%	17.4%
Light	3.1%	4.3%
Mixed, day to day	7.8%	2.9%

Self-Assessed Fluid Intake and Hydration Status

Table 26 contains summary ratings for difficulty of obtaining water, how often enough water was obtained, and thirst. There were no significant differences between the groups. Both groups found it "moderately easy" to obtain water, "almost always" obtained enough, but reported being thirsty "sometimes" to "fairly often." These findings correspond to the intake data which showed no difference between groups and both groups were well hydrated. Obtaining adequate water supplies was not a problem in this study.

Table 26. Water procurement and thirst

Item	GP	GP-I
Difficulty of obtaining water*	2.9±1.5	2.7±1.6
How often obtained enough water†	5.0±0.9	5.1±1.0
Thirst†	3.3±1.1	3.3±1.1

* Nine-point scale (1=Extremely Easy and 9=Extremely Difficult)
† Six- point scale (1=Never and 6=Always)

One-hundred percent in the GP group and 96 percent in the GP-I group reported that they purified their water. All subjects used iodine for purification. Ninety-three percent in the GP group and 98 percent in the GP-I group obtained their water from a stream.

Both groups reported adding water to the Coffee and Soup and Gravy Base "sometimes" to "fairly often." There was a low incidence of subjects adding water to the Cornflake and Granola Bars. Several subjects wrote on their questionnaires that they would have added water if they had known that they could.

In the GP group, 48.4 percent said they drank enough during the exercise, while in the GP-I group 66.7 percent said they drank enough. In both groups, the most frequent reasons for not drinking enough were not feeling thirsty or not feeling that more water was needed (14% in the GP group and 10% in the GP-I group).

Heating Water for the Rations

Forty percent of the GP and 30 percent of the GP-I group reported that they heated water several times to prepare the Coffee and Soup and Gravy Base. Thirty-two percent in the GP and 39 percent in the GP-I group never heated water for their rations. In both groups, 55 percent reported using a campfire to heat water. When asked on the final questionnaire whether including a canteen cup or some device like it in the rations was important, both groups thought it was "very important." Several students indicated that it would be helpful if the GP can could be used to cook in if no canteen cup was provided. The original model of can could be used to cook in but the new can, because of the materials and lining, cannot be used for cooking.

The students were asked in an open-ended question on the final questionnaire if there was any essential equipment needed for ration preparation or foraging that was not provided in the rations. The GP group listed: a can that can be cooked in, fork or spoon, snare wire, matches, salt and iodine. The GP-I group listed: metal container to cook in, fork or spoon, salt and damp proof box to put the ration in.

DISCUSSION

The purpose of this study was to conduct an operational field test of the GP-I survival ration prototype and compare it against the current survival ration during a simulated survival scenario. Although the actual physiological and emotional stress that an aircrew member would experience in a true life and death situation cannot be duplicated in a training or experimental setting, the US Air Force Combat Survival School provides aircrew members with a challenging survival exercise. The stresses and deprivation of the field survival test combined with an evasion exercise provided an adequate trial for the GP-I ration.

Although most humans can survive a few days of fasting with little long term consequence, even a small quantity of food can be effective in preventing the acute debilitating effects of total starvation. Further, it can have a profound impact on an individual's morale.

The GP-I was tested against the current military survival ration (GP) on 98 aircrew survival school students during June 1991. The results of the present study demonstrate that the GP-I can sustain aircrew members for five days without adverse physiological or psychological effects and is highly acceptable. The detailed results of this study are discussed below by topic area as outlined in the methods section.

NORMAL DIETARY INTAKE AND HEALTH HABITS

The purpose of administering the Health Habits and History Questionnaire was to estimate baseline dietary intake of the test subjects over a year's period. The results also serve as a tool to compare the usual intakes of the two groups, and to clarify any questionable intakes during the study with an individual's usual intake. The usual nutrient intake of both groups was similar and both groups met the MRDAs.

The usual nutritional intake of the test subjects was close to the average intake of U.S. men 20-29 years (31). The normal intake of protein (15% of kcal) for both groups was desirable. However, both groups exceeded the recommendation of 30-35 percent of total calories from fat (38% GP, 41% GP-I) and the 10 percent of calories for saturated fat (14% GP, 15% GP-I) (32). The recommendation for cholesterol intake of less than 300 mg per day by the Food and Nutrition Board's Diet and Health Committee was also exceeded by both groups (388 mg GP,

432 mg GP-I) (33). Excessive amounts of total fat, saturated fat and cholesterol may lead to an increased risk of coronary heart and vascular disease, obesity and cancer (34). Carbohydrates should contribute between 50 and 55% of total calories. The percent of calories coming from carbohydrate was lower than recommended (45% and 42% for the GP and GP-I groups, respectively).

Both groups fell within the target for sodium intake for military food service systems (1700 mg Na/1000 kcal) (32). Vitamin and mineral intakes were also well above that which is recommended (32).

The reported changes in weight for some subjects over the previous year indicates probable fluctuations in caloric intake. The caloric intakes reported appear to be within the range for weight maintenance. However, 73 percent of the GP group and 53 percent of the GP-I group reported a weight loss and/or gain of over 5 lbs within the past year. Such weight fluctuations may alter body composition resulting in a greater percentage of adipose tissue (35).

NUTRITION AND HYDRATION STATUS DURING FTX

Energy expenditure was estimated on the subgroup (N=25) to be 4700±2100 kcal/d over the five day FTX. Since caloric intake was approximately 750 kcal/d, subjects were consuming only 16 percent of their caloric needs, causing a 19,750 kcal deficit over the five days (3950 kcal/d x 5 d). As expected with such caloric deficits, subjects lost a significant amount of body weight, a mean loss for the combined groups of 3.1±1.9 kg, 4.0% BW (3.5 kg, 4.5% BW for GP and 2.6 kg, 3.4% BW for GP-I). Due to the short duration of the FTX it is difficult to determine the exact composition of the weight that was lost (i.e. glycogen, lean body mass, fat, and/or water). The best estimates, derived from anthropometry, indicate that of the 3.1 kg body weight lost, 35 percent came from fat free mass and 65 percent from fat mass. Dehydration could possibly have resulted in some weight loss; however, the fact that subjects had lower hemoglobin and hematocrits at the end of the study, in addition to high water intakes and low urine specific gravities, suggests that they were adequately hydrated and little of the weight loss could be attributed to dehydration.

Of the survival rations issued, caloric intake was only 48 percent (2151±877 kcal/d) for the GP group and 60 percent (2525±781 kcal/d) for the GP-I group. This low caloric intake cannot be attributed to just one cause but is a combination of factors that have been observed in past

field studies (36). The anorexia (reduced food intake even when food is readily available) seen during this study can probably be ascribe to ration palatibility, menu boredom, lack of time to eat, decreased appetite due to increased exercise, anxiety due to simulated survival conditions, a commitment to eat only foraged foods, and intentional dieting.

It has been hypothesized that the fuel stores used during the first few days of semistarvation are primarily carbohydrate (glycogen) and protein rather than fat (37). Glycogen reserves consist of approximately 350 g of muscle glycogen and 85 g of liver glycogen (37). Consequently, if an individual were to utilize his total glycogen reserve it would account for approximately 0.5 kg body weight loss. Further, an individual will lose approximately 40 g body protein/d during semistarvation (38). This would amount to approximately 0.3 kg body weight loss. Glycogen and body proteins are stored in an aqueous solution of approximately 3 g water/g of glycogen or protein (37). The weight losses observed during this study were most likely due to a depletion of the subject's hydrated glycogen and body protein stores in addition to body fat stores.

It has long been known that administration of carbohydrate in early fasting decreases nitrogen loss and spares sodium and water by preventing starvation ketoacidosis. In a classic study of life raft rations, Gamble (38) showed that when healthy young controls fasted for six days they lost approximately 400 g of body protein and 1200 ml of associated water. When subjects were provided with 50 g glucose/d there was a substantial reduction of the protein loss. When 100 g glucose/d was given the protein loss was reduced by half, but 200 g glucose provided little increased protection against body protein loss. These data indicate that providing at least 100 g glucose/d will spare body proteins which decreases the urine volume necessary to excrete its by-products. Although subjects in this study only consumed an average 85 g CHO/d, both rations contained well over the recommended 100 g CHO/ration. If the GP and GP-I groups had eaten their entire ration allotments they would have consumed 127 g and 109 g CHO/d, respectively.

The protein content of survival rations is intentionally limited to approximately 8 percent of total kilocalories to minimize the amount of water military personnel must drink to dispose of nitrogenous waste products.. Quinn et al. (39-40) showed in his comparison of protein-free versus protein-supplemented diets that protein added to the 900 kcal basal diet (0 g pro/d versus 43 g pro/d) increased body water loss, did not improve nitrogen balance, produced ketouria, and was used mainly as a source of fuel. In this study approximately 17 percent (159 g pro/5 d) of the calories were derived from protein. Ration items provided 6 percent of calories

(38 g pro/5 d) from protein while supplementary and foraged foods contributed the other 11 percent of total kcals from protein (121 g pro/5 d). To metabolize 159 g instead of 38 g of protein, 968 ml (about 32 oz) of extra water was required. Since maintaining water balance during a survival situation may sometimes be difficult, sparing water by consuming less protein may be important. The trade off between extra calories obtained by foraging and their effect upon water requirements requires a situation-specific evaluation.

The percentage of calories coming from fat was significantly different between ration groups (34% GP; 41% GP-I). A deficit in dietary fat intake relative to fat combustion has little direct or immediate influence on the physiological function or nutritional status of military personnel. Short-term fat requirements are normally met from a large body fat energy reserves that has no immediate metabolic function, but serves solely as a readily-mobilized energy reserve to meet any shortfall in food energy intake (41). While negative energy balance can lead to starvation over the long-term, fat energy deficits during short-term military operations are of little concern. This contrasts with the more serious consequences that deficits in water and CHO intake can have during life and death survival situations. This inclusion of fat in survival rations beyond that needed to improve palatability, and perhaps satiety, may be counterproductive in that it reduces the mass and/or volume available in the ration for carbohydrates needed to maintain physical and mental performance.

Any sodium consumed in excess of the metabolic requirement will be excreted, thus increasing the urine void volume for that day which adversely affects fluid balance especially when water is scarce. As with protein, a low but adequate amount of this mineral will spare body water by reducing the amount that is needed to excrete excess amounts of sodium. Since water availability is often a problem during a survival situation, the sodium content of survival rations is limited to about 2 g. Subjects consumed an average of 1.6 g sodium/d in this study.

Blood chemistries changed significantly pre- to post-study but most variables remained within normal physiological limits. The exceptions were: uric acid, bilirubin, creatine kinase (CK), lactic acid dehydrogenase (LD), and aspartate amino transferase (AST). Uric acid is formed from the breakdown of nucleic acids and is an end product of purine metabolism (42). An increase in the production of uric acid occurs when there is excessive cell breakdown and catabolism of nucleic acids as would be seen during starvation and/or stress which probably accounts for the elevations in these subjects (42). Bilirubin is produced from the breakdown of hemoglobin of red blood cells (42). Increases in physical activity by untrained individuals have been associated with increased red blood cell destruction (hemolysis) (42). One of the causes could be

mechanical trauma inflicted on the capillaries of the feet from marching or running (43). Other factors may include elevated body temperatures, increased blood flow, acidosis, and the effects of catecholamines (44). All these factors could possibly have affected test subjects in this study. Creatine kinase (CK), lactic acid dehydrogenase (LD) and aspartate amino transferase (AST) are all enzymes that are found in high concentrations in skeletal muscle (42). The increased levels of these enzymes in serum of subjects was probably the result of exercise-induced skeletal muscle trauma occurring during the FTX (45).

Blood lipid values were all within accepted ranges. Cholesterol and triglycerides values tended to decrease pre- to post-study. Further, there was an increase in the HDL fraction and a decrease in the LDL fraction of cholesterol. These types of changes have been observed during other field operations (46-47) and during periods of semi-starvation, elevated work levels and weight loss (48).

Adequate water intake is vital to maintaining physical performance and the well being of military personnel during survival situations. Minimum water requirements for survival under temperate conditions have been estimated to be around 1 L water/d (3,37,49,50). Water intakes below 1 L/d will result in physical deterioration. Of course, water requirements increase with elevated environmental temperature and work loads. It is generally recommended that soldiers drink 4-6 L water/d to remain hydrated under temperate weather conditions (51). This would include water used to rehydrate food and beverage items, moisture in food and drinking water. Students were educated about the amount of water necessary to maintain water balance and were encouraged to drink plenty of water during their training exercise.

Current techniques for assessing water intake and hydration status are cumbersome and obtrusive. Consequently, a need exists for a more easily applied method for measuring the water intakes of military personnel in the field. Measurement of water use by military personnel will help define general standards for field water requirements. The generally accepted method of estimating water intake is by logbook. This approach is susceptible to random errors since the subjects must estimate and record their water intakes throughout the study period. For this reason a new stable isotope (^2H_2O) elimination method was evaluated by comparing it to the established logbook recording method.

In spite of adverse field conditions, the ^2H_2O elimination method gave valid estimates of group mean water intake relative to the established method of recording water intake by logbook. Water intake by the ^2H_2O method and by logbook records did not differ significantly (^2H_2O

method 4164±930 g/d, self-reported 4535±1406 g/d, difference 6±19%)($p>0.05$). Graphical comparison of the methods (52) suggests that they agree sufficiently to permit the replacement of the indirect and obtrusive logbook method for estimating group mean water intake with the new ^2H_2O elimination method.

Hydration status was also evaluated using total body water, hemoglobin, hematocrit, serum osmolality, serum proteins, and urine specific gravity. None of the measurements reported were significantly different between ration groups. Total body water, serum proteins and urine specific gravity remained relatively unchanged pre- to post-study. There was a significant decrease in hemoglobin, hematocrit, and serum osmolality pre- to post-study which suggests an increase in circulating blood volume. It has been demonstrated that blood volume can increase after continuous, short-term training (53-54). These data suggest that subjects had no hemoconcentration and were adequately hydrated at the time the study was concluded. Further, both rations maintained hydration status equally well during the FTX.

MOOD RATINGS

Based on visual observations by the test administrators, the facial expressions and attitudes of the students were noticeably different from the pre- to posttest sessions. They appeared to be exhausted and "flat" during the posttest session. The low mood scores of the subjects were consistent with these observations.

The mood ratings were indicative of the strain imposed by field conditions and a predictable result of fatiguing training activities. At the beginning of the study the students were walking around, setting up camp and listening to the instructors which was a more relaxed atmosphere than the second half of the study. Towards the end, the students were practicing evading the "enemy," who were represented by the course instructors. The last day they practiced evasion techniques while orienteering a complex course to the final point where the buses were waiting. This could explain why their "tension" ratings increased significantly on the last day and why there was not a change in the ratings showing a positive anticipation of exiting the field.

Trends in the mood data indicated a decline in positive attitudes and an increase in negative ones. Though there were no significant between group differences in mood to indicate that one ration was better than the other, the data do show that the students found the training stressful.

Although the subjective scores for "fullness," "thirst," and "hunger" can be to some extent explained by inadequate caloric intake, they can also be partially explained by the fact that the students consumed a large mess hall breakfast just prior to going to the field. The morning ratings from the first day were not true field ratings.

RATION ACCEPTANCE

The field acceptability ratings for both rations, in the range of 6 to 9, were within acceptable standards. For example, an average rating of 7 or "like moderately" is felt to indicate a very good product by the ration developers (55). The individual food items were all rated above "like slightly," with the exception of coffee. This may have been due to the low number of people who consumed coffee, which was most likely because of personal preferences since water and heating were equally available to both groups. Coffee packets were provided in every ration.

The final questionnaire ratings for individual food items were lower than the field ratings. Ratings for the cornflake and rice and the cornflake bars were virtually identical. Given that the two bars were very similar in appearance and texture, it's possible that the students couldn't retrospectively distinguish the bars enough to accurately rate them individually. However, the field data show that even when the students rated the bars with the identification of their labelled wrappers, student perception of acceptability was much the same for each of the two bars. The GP group was also very dissatisfied with the variety and since the bars they received were very similar, taste, appearance and overall acceptability ratings were negatively affected.

The very low rating for variety in the GP reflects the composition of the ration. The GP-I had five different bars while the GP was supposed to have three bars. Unfortunately, many students in the GP group did not receive granola bars and the cornflake and rice and cornflake bars were very similar in appearance and texture, hence there was no variety.

The relatively lower final questionnaire ratings, compared to field ratings, are typical of other studies (56). Previous work (56) has shown that final questionnaire ratings are predictably lower than field ratings as an effect of the subjects rating retrospectively and indicating dislike for items they might have avoided eating, and therefore avoided rating, in the field.

It was apparent from the final questionnaire that the students thought a survival ration was a great idea and would help them in a survival situation. They expressed concern about

including coffee in the ration, as opposed to beverage base, cocoa, powdered milk or extra soup mix, possibly because of the high number of people who were not coffee drinkers. Also the diuretic effect of coffee could be detrimental in a low water situation. The students would like to see less cereal and candy and the addition of something salty like jerky, dried meat, dried fruit, or peanut butter and crackers. The cornflake and cornflake and rice bars should be less dry and hard and a little more chewy. The GP was perceived as being harder than the GP-I. In fact, the GP-I group asked for fewer sweet things and the GP group asked for more. A compromise between the two might be a solution.

Human Factors

It was also apparent from the final questionnaire that there were some problems with the instructions on the rations. Many students did not realize that they could add water to some of the bars to make them more cereal-like. This may have also affected the ratings for acceptability and variety because the students were not able to fully utilize the rations. The instructions were printed on the outside of the GP can and the GP-I instructions were pasted on the box. Perhaps putting instructions right on the bar packaging itself would help. This would prevent the instructions from getting lost if the ration is taken out of the container and divided up, which would probably happen in a survival situation.

On the final questionnaire, the students particularly indicated that inclusion of salt, a container to cook in, a utensil, and perhaps snare wire, iodine or matches was important to help prepare the ration and aid foraging efforts. A high number of subjects in both groups reported heating water to prepare their coffee and soup and gravy base. Obtaining water was not a problem and everybody who purified their water used iodine. It might be useful to survey the current survival course instructors, perhaps using a similar questionnaire as was used for the students, for additional suggestions for improvements or items to be included in the rations that might not otherwise be available, since both groups supplemented the rations extensively with foraged items.

The GP-I cardboard box should be replaced with flexible, waterproof packaging, preferably resealable, or a rounded metal container that can be cooked in. The students indicated verbally and on the final questionnaire that the GP-I box disintegrated when it got wet and became useless trash. The metal container of the GP was worse because it was relatively heavy and was not useful since it was not safe to cook in. The metal box may be the reason why the GP

group was significantly less satisfied with how easy the ration was to pack and carry. Otherwise, the size and weight of the rations were not a problem. The ability to eat some of a bar and rewrap it in the foil package was appreciated by most; others felt the foil was trash that had to be carried out to avoid leaving the enemy evidence of existence.

Overall both rations were nutritionally adequate and did not adversely affect hydration. The improved survival ration (GP-I) was, however, more palatable which in itself is sufficient grounds for recommendation.

CONCLUSIONS

The results of this test show that both rations had similar effects on body weight loss and hydration status. The GP-I group did consume significantly more kilocalories in the form of fat. The extra fat consumed during this FTX probably moderated the body weight loss but had little positive effect on either physiologic response or nutritional status of the subjects since short-term energy deficits can be met by using body fat stores.

The individual foods in both the GP and the GP-I received acceptable ratings. The variety of the GP-I is more desirable than the GP. The GP-I, with improvements, is the ration that should be used in the future. The coffee should be replaced with a hot or cold beverage powder. Rehydration instructions should be printed on each bar wrapper. The GP-I paperboard box should be replaced with either a can or some type of water resistant box to prevent disintegration of packaging.

RECOMMENDATIONS

1. Maintain the variety of textures and tastes in the GP-I.

2. Replace the coffee with some other type of hot or cold beverage powder.

3. Place rehydration instruction on each bar package.

4. Replace GP-I paperboard box with either a can or some type of water resistant box to prevent disintegration of packaging.

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APPENDIX A
NUTRIENT COMPOSITION DATA

RECORD OF NUTRITIVE VALUES FOOD PACKET SURVIVAL GENERAL PURPOSE

09/18/89

ALT MENU	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
CORNFLAKE BR	2.87	4.72	10.49	.63	4	18	.41	232	87	7	.45		
GRANOLA BAR	6.01	13.72		1.70	76	266	22.79	280	282	83	.61		
RICE/CORN BR	2.89	5.60	10.43	.65	5	24	1.31	205	90	7	.41		
COFFEE INSTA	.06	.00	.00	.24	4	10	.14	2	81	8	.00		
SUGAR	.00	.00	.00	.03	0	0	.01	0	0	0	.00		
SOUP/GR BSCH	.08	.55	.69	2.94	3	3	.11	1212	6	0	2.32		
SUM	11.93	24.59	21.61	6.19	92	321	24.78	1931	547	105	3.80		

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
CORNFLAKE BR	330	.035	390		.03	.18	.7	.03	16	.03	2.27	37.98	265	57
GRANOLA BAR	6270		6270		1.88	1.25	23.1	5.64			1.74	91.97	423	113
RICE/CORN BR	680	.031	730	2	.26	.45	5.0	.31	60	.03	3.63	37.13	265	57
COFFEE INSTA				15		.01	.8	.00				2.19	9	3
SUGAR	0	.000	0	0	.00	.00	.0	.00				5.97	24	6
SOUP/GR BSCH						.00	.0	.00				2.74	19	7
SUM	7280	.066	7390	17	2.17	1.88	29.7	5.98	76	.06	7.63	177.99	1005	242

Food Packet, Survival, General Purpose, Improved

NUTRITIONAL ANALYSIS
July 15, 1991

Component	Wt (g)	Water (g)	Pro (g)	CHO (g)	Fat (g)	Kcal	Sodium (mg)	Potas (mg)	Ash (g)	alciu (g)	Phos (mg)	Magne (mg)	Iron (mg)	Zinc (mg)	Vit A (iu)	Vit C (mg)	Thiam (mg)	Ribo (mg)	Niacin (mg)	B-6 (mcg)	Vit E (mg)	Folacin (mcg)
Cornflake bar (2)	90.0	2.5	6.1	59.1	20.0	441.0	836.0	190.0	1.3	73.0	95.0	13.0	1.7	0.0	1122.0		0.6	0.8	13.0		4.4	158.0
Shortbread	45.0	5.4	2.4	26.5	10.4	209.0	97.5	24.5	0.1	20.4	21.4	5.9	0.7	0.2	185.0	0.0	0.2	0.1	1.2	0.0	8.7	4.9
Charms candy	28.0	0.3	0.0	28.0	0.8	110.0	9.0	1.0	0.0	6.0	2.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Granola bar	43.0	1.6	4.4	31.0	10.2	234.0	50.0	147.0	0.6	20.0	111.5	38.5	1.0	0.9	130.0		0.1	0.1	0.7	0.0	0.6	13.5
Chocolate chip bar	55.0	0.8	4.8	26.7	22.8	332.0	161.0	168.0	0.8	15.0	112.0	47.0	1.6	1.1	170.0		0.2	0.1	1.1	0.1	2.9	9.0
Coffee,Instant	3.0	0.1	0.0	2.2	0.0	9.0	2.0	81.0	0.2	4.0	81.0	8.0	0.1			15.0		0.0	0.8	0.0		
Sugar	6.0	0.0	0.0	6.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Soup/Gravy Base	7.0	0.1	0.6	2.7	0.7	19.0	1212.0	6.0	2.9	3.0	3.0	0.0	0.1					0.0	0.0	0.0		
Total	277.0	10.8	18.3	182.2	84.9	1378.0	2367.5	617.5	5.9	141.4	425.9	112.4	5.7	2.1	1607.0	15.0	1.0	1.1	16.8	0.1	16.5	185.4
Kcal			73.3	728.7	584.5																	
Percent total Kcal			5.3	52.9	42.4																	

APPENDIX B
VOLUNTEER AGREEMENT AFFIDAVIT

VOLUNTEER AGREEMENT AFFIDAVIT

For use of this form, see AR 70-25 or AR 40-38; the proponent agency is OTSG

PRIVACY ACT OF 1974

Authority	10 USC 3013; 44 USC 3101; and 10 USC 1071-1087
Principle Purpose	To document voluntary participation in the Clinical Investigation and Research Program. SSN and home address will be used for identification and locating purposes.
Routine Uses	The SSN and home address will be used for identification and locating purposes. Information derived from the study will be used to document the study, implementation of medical programs, adjudication of claims, and for the mandatory reporting of medical conditions as required by law. Information may be furnished to Federal, State and local agencies.
Disclosure	The furnishing of your SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in the investigational study.

PART A(1) - VOLUNTEER AFFIDAVIT

Volunteer Subjects in Approved Department of the Army Research Studies

Volunteers under the provisions of AR 40-38 and AR 70-25 are authorized all necessary medical care for injury or disease which is the proximate result of their participation in such studies.

I, _____, SSN _____

having full capacity to consent and having attained my _____ birthday, do hereby volunteer/give consent as legal representative for _____ to participate in A Field Evaluation of the Nutritional Intake and Acceptability of the New Generation Survival Ration (NGSR) Consumed in a Temperate Environment

(Research Study)

under the direction of COL E. Wayne Askew

conducted at Fairchild Air Force Base, WA

(Name of Institution)

The implications of my voluntary participation/consent as legal representative, duration and purpose of the research study, the methods and means by which it is to be conducted, and the inconveniences and hazards that may reasonably be expected have been explained to me by COL Askew AV 251-4874 or (508)651-4874

Contact telephones: Ms. Tanya E. Jones AV 251-4803 or (508)651-4803

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights/the rights of the person I represent or study related injury, I may contact:

Office of Chief Counsel

at US Army Natick Research, Development and Engineering Center (508)651-4322

(Name, Address and Phone Number of Hospital (Include Area Code))

I understand that I may at any time during the course of this study revoke my consent and withdraw/have the person I represent withdrawn from the study without further penalty or loss of benefits; however, if the person I represent may be required (military volunteer) or requested (civilian volunteer) to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my/the person I represent's health and well-being. My/the person I represent's refusal to participate will involve no penalty or loss of benefits to which I am/the person I represent is otherwise entitled.

_____

PART A (2) - ASSENT VOLUNTEER AFFIDAVIT (MINOR CHILD)

I _____, SSN _____, having full capacity to assent and having attained my _____ birthday, do hereby volunteer for _____ to participate in _____

(Research Study)

under the direction of _____

conducted at _____

(Name of Institution)

(Continue on Reverse)

PART A(2) - ASSENT VOLUNTEER AFFIDAVIT (*MINOR CHILD*) (Cont'd.)

The implications of my voluntary participation, the nature, duration and purpose of the research study, the methods and means by which it is to be conducted, and the inconveniences and hazards that may reasonably be expected have been explained to me by

_____

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights I may contact

_____

at _____

(Name, Address, and Phone Number of Hospital (Include Area Code))

I understand that I may at any time during the course of this study revoke my assent and withdraw from the study without further penalty or loss of benefits, however, I may be requested to undergo certain examination if, in the opinion of the attending physician such examinations are necessary for my health and well being. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled.

_____

PART B - TO BE COMPLETED BY INVESTIGATOR

INSTRUCTIONS FOR ELEMENTS OF INFORMED CONSENT *(Provide a detailed explanation in accordance with Appendix C, AR 40-38, AR 70-25.)*

Description

We are requesting your participation in a five day research study. The purpose of this study is to evaluate the suitability and acceptability of the New Generation Survival Ration (NGSR) and old General Purpose Survival Packet as the sole sources of food for soldiers for five consecutive days. The study will be conducted in conjunction with your normal field training exercise (FTX). You will be given either the NGSR or the old General Purpose Survival Packet to eat. You will not be permitted to supplement this ration by bringing your own food into the field.

Before deploying you will be asked to fill out a questionnaire which will assess your usual dietary practices. Also your height and weight will be taken and you will be asked to provide a small sample of the first urine that you pass in the morning. You will also be briefed on how to accurately fill out your daily dietary log sheets.

I **do** ☐ **do not** ☐ *(check one & initial)* consent to the inclusion of this form in my outpatient medical treatment record

SIGNATURE OF VOLUNTEER	DATE	SIGNATURE OF LEGAL GUARDIAN *(If volunteer is a minor)*
PERMANENT ADDRESS OF VOLUNTEER	TYPED NAME OF WITNESS	
	SIGNATURE OF WITNESS	DATE

You may have measurements taken of your neck, arm, back, hip, and waist which will give us information on your body fat percent. You may also have a pre and post-experiment blood sample taken which will be collected with a small sterile needle from your arm. These blood samples will help us to monitor the state of your metabolism. There is a small risk of a hematoma or bruise forming on the puncture site, but if this occurs it will gradually disappear. This procedure will be performed using a sterile technique by a skilled technician. The total amount of blood withdrawn will be 24 ml.

You may be asked to wear a device for measuring your level of activity. This compact, lightweight, battery-powered monitor will be attached to your wrist and worn for the duration of the study. There is no risk of electrical shock.

We may also wish to determine your water requirements during your field exercise by having you drink a special form of water that can be distinguished from the water already in your body by special tests. It is present in natural water in small amounts and is not radioactive. The modified water you will drink is safe. We will allow time for the modified water you drink to mix with your body water (3 to 4 hours). You will then collect samples of your saliva for analysis. While out in the field you will collect a small sample of the first urine that you pass in the morning. Your urine will be analyzed for modified water concentrations. The rate of excretion of modified water from your body will be used to determine the amount of water you use during your field exercise. We may also want to estimate how much total body water you have by measuring the electrical resistance of your body. This is done by attaching two electrical connectors pads to your right hand and foot. An electrical current which you will not be able to feel will be passed through your body and a measurement of the conductivity of your body will be made. There is no risk of electrical shock. Upon completion of the FTX the above procedures, as described, will be repeated.

While you are consuming the NGSR you will be asked to fill out a daily dietary log. This will provide information on your food and water consumption. These log sheets should take little of your time and should only be a minor inconvenience but will provide important information needed to evaluate the ration and to determine the amount of energy you take in as food. A small sample of the first urine that you pass in the morning will also be collected daily. The concentration of these urine samples may help indicate whether your water consumption is adequate.

Upon returning from the field your body weight will be taken again. You will also be asked to fill out a questionnaire which will provide the ration developers with information needed to improve the taste, packaging and ease of use of the rations.

Risks and Benefits

The risks of consuming a "survival ration" for five days are weight loss and feelings of hunger. This ration would be used in case of emergency. Your projected loss of body weight may be 2-4 lbs for the entire five day study. You should regain this weight when you return to a garrison environment.

Participation in this study is on a voluntary basis. However, if you choose not to take part or if you choose to withdraw from the study, you will not be excused or withdrawn from the field. The decision to remove you from the field would be made by your local senior military commander.

The information you give, together with the other information that we will collect, will be treated in the strictest confidence and will not be revealed to any person who is not authorized to receive it or has no need to know. However you should know that complete confidentiality cannot be promised, particularly to subjects who are military personnel, because information bearing on your health may be required to be revealed to appropriate medical or command authorities. Information about you may be inspected by the officials of the US Army Medical Research and Development Command.

You will be participating in a field exercise and consuming either the New Generation Survival ration or old General Purpose Survival Packet for five consecutive days as part of your regular Army activity. You will receive no direct benefit from participating in this study other than to know that you have contributed to the fielding of the NGSR. This ration may help you in an emergency situation. Your data, comments and suggestions will be carefully evaluated and may lead to beneficial changes in the design and/or content of this ration.

Before you sign this document, be sure that you have read it and fully understand it. If you have any questions concerning this study or your results please ask so you have a complete understanding of the nature and details of the study. A second copy of this Agreement Form is provided here for your information and retention.

APPENDIX C
STUDENT REQUIRED EQUIPMENT LIST (SUMMER)

STUDENT REQUIRED EQUIPMENT LIST (SUMMER)

1. AFR 50-5 items:

a. Boots, combat (no zipper)	1 pair - 2 lbs
b. Cap, BDU, Fatigue, Flight	1 each - 2 oz
c. Coverall, flying or fatigues, long sleeve	2 pairs fatigues - 2 lbs 6 oz per pair flight suit - 2 lbs
d. Flashlight, 2 cell	1 each - 12 oz
e. Socks, wool or cushion sole	5 pairs - 6 oz/pair
f. Gloves, leather or nomex	1 pair - leather - 5 oz
g. Tags, ID	1 set - 2 oz
h. Watch	1 each - 3 oz

2. Survival issued items:

a. Field jacket	1 each - 3 lbs 3 oz
b. Cup, water canteen	1 each - 8 oz
c. Survival vest	1 each - 1 lb/empty
d. Mirror, signal	1 each - 2 oz (small)
e. Knife, pocket	1 each - 3 oz
f. Poncho	2 each - 1 lb 8 oz/each
g. Bag, sleeping	1 each - 8 lbs 2 oz
h. Case, sleeping bag	1 each - 2 lbs 5 oz
i. Plastic bag, large clear	1 each - 2 oz
j. Cover, canteen	2 each
k. Canteen, plastic	2 each - 2 lbs 14 oz full with cover/each
l. Compass, lensatic	1 each - 6 oz
m. Water purification tablets	2 each - 1 oz each
n. Insect repellant	1 each - 2 oz
o. Ziplock plastic bag	1 each - 1/4 oz
p. All issued food stuff	1 each - 3 lbs 13 oz
q. SRU-21/P Survival vest	4 lbs 5 oz/total/1 each

McClouds and shovels stored at CP for fire circles.

3. Element issued items:

a. Water bag, 5 qt plastic	3 each - 10 lbs 14 oz w/cover, full/each
b. Toilet paper	1 roll - 9 1/2 oz
c. Hatchet	1 each - 1 lb 15 oz
d. Snare wire	100 ft - 1 1/2 oz
e. Stone	2 each - 3 oz/each
f. File	2 each - 2 oz/each
g. Entrenching tool	1 each

4. Field Training issued items:

a. Map	1 each - 6 oz w/ziplock
b. Candle	1/2 each - 1 oz
c. Camouflage stick	1/3 each - 1 oz

5 Required personal items:

a. Matches or lighter	1 each - 1/2 oz
b. Pencil, wooden	1 each - 1 oz
c. Notepad	1 each
d. Bands, blousing	1 pair
e. Improvised equipment	All IG requirements - 5 lbs
f. Towel	1 each - 7 oz
g. Soap	1 each - 2 oz
h. Razor, safety	1 each - 1 oz

6. Optional items:

a. Personal survival kits (app. by staff)	1 each - 3 oz
b. Minimum first aid kit (app. by staff)	1 each - 1 lb
c. Small fishing kit	1 each - 6 oz
d. Foot powder	1 each - 1 oz
e. Tobacco products or gum (5-7 stick)	5 packs
f. Sunglasses	1 pair
g. Metal match	1 each - 1 oz
h. Needle nose pliers	1 each - 8 oz

APPENDIX D
HEALTH HABITS AND HISTORY QUESTIONNAIRE

DIET HISTORY AND HABITS QUESTIONNAIRE

THANK YOU for filling this out. It provides valuable information about your health habits, and it will also provide a good estimate of your dietary intake. There are instruction about filling out the diet section in the booklet itself. However, here are a few pointers about how to fill it out, or about items which some people have found confusing.

IN THE FOOD SECTION:

1. WRITE NUMBERS in the boxes to indicate how many times per day, week or month you eat a food.

2. DON'T SKIP items. If you rarely or never eat a food, check "Rarely/Never".

3. BE CAREFUL about which column you put your answer in. It will make a big difference in the calculations if you check "Hamburgers once a day" when you mean "Hamburgers once a week".

4. NOTICE that there are three kinds of cereals. Be careful that you don't triple- count here, and wind up with cereal 15 times a week when you really mean cereal 5 times a week.

5. Keep in mind also for the three kinds of bread, and three kinds of milk.

6. NOTICE that a medium serving of eggs is stated as two eggs. If you normally only have one egg, check "small".

NAME:_____

SUBJECT NUMBER:_____

REVIEWER:_____

U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE (USARIEM)
MILITARY NUTRITION DIVISION
NATICK, MA 01760-5007

PERSONAL INFORMATION, HABITS

1. When were you born? ____/____/____ (Month Day Year) — 11

2. How old are you? ____ years — 18

3. Sex: 1 __ Male 2 __ Female — 20

4. Race or ethnic background:
   1 __ White, not of Hispanic origin
   2 __ Black, not of Hispanic origin
   3 __ Hispanic
   4 __ American Indian/Alaskan native
   5 __ Asian
   6 __ Pacific Islander — 21

5. Please circle the highest grade in school you have completed:
   1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16+ — 22

6. What is your marital status? 1 __ Single 2 __ Married 3 __ Widowed 4 __ Divorced/Separated — 24

7. How many times have you moved or changed residences in the last ten years? __ times — 25

8. Have you smoked at least 100 cigarettes in your entire life? 1 __ No 2 __ Yes **If Yes,** — 27

   IF YES: About how old were you when you first started smoking cigarettes fairly regularly?
   ____ years old — 28
   On the average of the entire time you smoked, how many cigarettes did you smoke per day?
   ____ cigarettes per day — 30
   Do you smoke cigarettes now? 1 __ No 2 __ Yes — 32
   IF NO: How old were you when you stopped smoking? ____ years old — 33
   IF YES: On the average, about how many cigarettes a day do you smoke now? ____ cigarettes — 35

9. Have you ever smoked a pipe or cigars regularly? 1 __ No 2 __ Yes **If Yes,** — 37

   IF YES: For how many years? ____ years — 38
   About how much? ____ pipes or cigars per _____ (day or week) — 40

10. During the past year, have you taken any vitamins or minerals?
    1 __ No 2 __ Yes, fairly regularly 3 __ Yes, but not regularly **If Yes,** — 43

    What do you take fairly regularly? # of PILLS per DAY, WEEK, etc.

    Multiple Vitamins
    - One-a-day type: _____ pills per _____ — 44
    - Stress-tabs type: _____ pills per _____ — 47
    - Therapeutic, Theragran type: _____ pills per _____ — 50

    How many milligrams or IUs per pill?

    Other Vitamins
    - Vitamin A: _____ pills per _____ → _____ IU per pill — 53
    - Vitamin C: _____ pills per _____ → _____ mg per pill — 57
    - Vitamin E: _____ pills per _____ → _____ IU per pill — 61
    - Calcium or dolomite: _____ pills per _____ → _____ mg per pill — 65

    Other (What?) 1 __ Yeast 2 __ Selenium 3 __ Zinc 4 __ Iron 5 __ Beta-carotene
    6 __ Cod liver oil 7 __ Other _____ — 69

    Please list the brand of multiple vitamin/mineral you usually take: _____

FOR OFFICE USE
Q10 mg or IU: 1 = 50-100 2 = 200-250 3 = 400-500 4 = 1000 5 = 5000 6 = 10,000 7 = 20,000-25,000 8 = 50,000 9 = Unk

	Medium Serving	Your Serving Size			How often?					OFFICE USE
					Day	Week	Month	Year	Rarely/ Never	
FRUITS & JUICES		S	M	L						
EXAMPLE – Apples, applesauce, pears	(1) or ½ cup		✓			4				
Apples, applesauce, pears	(1) or ½ cup									11
Bananas	1 medium									15
Peaches, apricots (canned, frozen or dried, whole year)	(1) or ½ cup									19
Peaches, apricots, nectarines (fresh, in season)	1 medium									23
Cantaloupe (in season)	¼ medium									27
Watermelon (in season)	1 slice									31
Strawberries (fresh, in season)	½ cup									35
Oranges	1 medium									39
Orange juice or grapefruit juice	6 oz. glass									43
Grapefruit	(½)									47
Tang, Start breakfast drinks	6 oz. glass									51
Other fruit juices, fortified fruit drinks	6 oz. glass									55
Any other fruit, including berries, fruit cocktail	½ cup									59
VEGETABLES		S	M	L	Da	Wk	Mo	Yr	Nv	
String beans, green beans	½ cup									63
Peas	½ cup									67
Chili with beans	¾ cup									71
Other beans such as baked beans, pintos, kidney beans, limas	¾ cup									75 D 79
Corn	½ cup									11
Winter squash, baked squash	½ cup									15
Tomatoes, tomato juice	(1) or 6 oz.									19
Red chili sauce, taco sauce, salsa picante	2 Tblsp. sauce									23
Broccoli	½ cup									27
Cauliflower or brussel sprouts	½ cup									31
Spinach (raw)	¾ cup									35
Spinach (cooked)	½ cup									39
Mustard greens, turnip greens, collards	½ cup									43
Cole slaw, cabbage, sauerkraut	½ cup									47
Carrots, or mixed vegetables containing carrots	½ cup									51
Green salad	1 med. bowl									55
Salad dressing, mayonnaise (including on sandwiches)	2 Tblsp.									59
French fries and fried potatoes	¾ cup									63
Sweet potatoes, yams	½ cup									67
Other potatoes, including boiled, baked, potato salad	(1) or ½ cup									71
Rice	¾ cup									75 E 79
Any other vegetable, including cooked onions, summer squash	½ cup									11
Butter, margarine or other fat on vegetables, potatoes, etc.	2 pats									15
MEAT, FISH, POULTRY & MIXED DISHES		S	M	L	Da	Wk	Mo	Yr	Nv	
Hamburgers, cheeseburgers, meat loaf	1 medium									19
Beef—steaks, roasts	4 oz.									23
Beef stew or pot pie with carrots, other vegetables	1 cup									27
Liver, including chicken livers	4 oz.									31
Pork, including chops, roasts	2 chops or 4 oz.									35
Fried chicken	2 sm. or 1 lg. piece									39
Chicken or turkey, roasted, stewed or broiled	2 sm. or 1 lg. piece									43
Fried fish or fish sandwich	4 oz. or 1 sand.									47
Tuna fish, tuna salad, tuna casserole	½ cup									51
Shell fish (shrimp, lobster, crab, oysters, etc.)	(5) ¼ cup or 3 oz.									55
Other fish, broiled, baked	4 oz.									59
Spaghetti, lasagna, other pasta with tomato sauce	1 cup									63
Pizza	2 slices									67
Mixed dishes with cheese (such as macaroni and cheese)	1 cup									71

14. Think about your diet over the last year and the responses you have just made on this questionnaire. Are there any foods not mentioned which you ate *at least once a week*, even in small quantities, or ate frequently in a particular season? Consider other meats, breakfast foods, catsup, green chilies or jalapenos, avocado (guacamole), Mexican dishes, Chinese or other ethnic foods, other fruits or vegetables, as well as nutritional supplements (bran, etc.). *Please take a look at the list of foods at the bottom of the page.*

FOOD	Your Serving Size			How Often?		OFFICE USE Code	Amounts
	S	M	L	Day	Week		
						11	
						17	
						23	
						29	
						35	
						41	

	1 Seldom/Never	2 Sometimes	3 Often/Always		
15. How often do you eat the skin on chicken?				47	
How often do you eat the fat on meat?				48	
How often do you add salt to your food?				49	
How often do you add pepper to your food?				50	

16. How often do you use fat or oil in cooking?
For example, in frying eggs, meat or vegetables? _____ times per _____ (day, week, month) — 51

17. What do you *usually* cook with? 1 ___ Don't know or don't cook 2 ___ Soft margarine
3 ___ Stick margarine 4 ___ Butter 5 ___ Oil 6 ___ Lard, fatback, bacon fat — 54
7 ___ Pam or no oil

18. What kind of fat do you *usually* add to vegetables, potatoes, etc?
1 ___ Don't add fat 2 ___ Soft margarine 3 ___ Stick margarine 4 ___ Butter — 56
5 ___ Half butter, half margarine 6 ___ Lard, fatback, bacon fat

19. If you eat cold cereal, what kind do you eat most often? _____ — 58

20. Not counting salad or potatoes, about how many vegetables do you eat per day or per week? _____ vegetables per _____ day, week — 61

21. Not counting juices, how many fruits do you usually eat per day or per week? _____ fruits per _____ day, week — 64

22. Have you gained or lost more than five pounds in the past year? (You may check more than one answer.)
1 ___ No 2 ___ Lost 5-15 lbs. 3 ___ Lost 16-25 lbs. 4 ___ Lost more than 25 lbs. — 67
5 ___ Gained 5-15 lbs. 6 ___ Gained 16-25 lbs. 7 ___ Gained more than 25 lbs.

68 9 9

DO YOU EAT THESE ONCE A WEEK?

veal, lamb	01	pancakes, waffles	21	onions	41	Hi-C	[illegible]
tofu	03	instant breakfast, metrecal	22	summer squash	42	cranberry juice cocktail	[illegible]
mixed dish w/meat	04	pudding	23	asparagus	43	grapes	[illegible]
mixed dish w/chicken	05	milkshake	24	sweet green peppers	44	mangoes	[illegible]
Chinese dishes	06	other diary product	25	sweet red peppers	45	papayas	[illegible]
Mexican dishes	07	other dessert, sweet	26	bean sprouts	46	honeydew or cassaba melon	[illegible]
seafood creole	08	sour cream, dips	31	avocado, guacamole	47	lemons or lemon juice	[illegible]
refried beans or bean burritos	09	diet salad dressing	32	beets	48	nuts and seeds	[illegible]

APPENDIX E
FINAL QUESTIONNAIRES

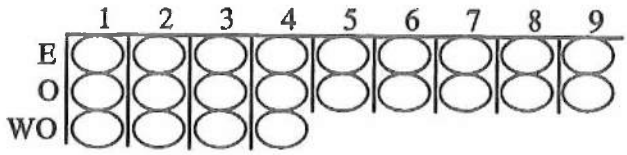
FINAL QUESTIONNAIRE

We would like to ask you some questions about the General Purpose Survival Packet (GP) which you ate during your field training exercise. Your opinions will be very important in determining any changes that will be made in the ration. Your answers will be kept confidential. Please answer honestly and thoughtfully. Please use a number two pencil to fill in the ovals. Thank you.

Please indicate your Social Security number. (Last four digits only)

_____

1. What is your rank?



2. How long have you been in the Armed Services? _____YEARS_____MONTHS

3. Have you ever had any survival training prior to thIs exercise? ◯ YES ◯ NO

4. What is your weight? _____LBS

5. What is your height? _____FT _____IN

6. What is your sex?
- ◯ Male
- ◯ Female

7. What is your age? _____

8. Are you currently trying to: ◯ lose weight? ◯ gain weight? ◯ neither?

9. Which ethnic group do you belong to? Please fill in one oval.
- ◯ American Indian/Alaskan Native
- ◯ Asian/Pacific Islander
- ◯ Black/African
- ◯ Hispanic
- ◯ White/Caucasian, not of Hispanic origin
- ◯ Other (please specify):_____

PLEASE USE A #2 PENCIL

10. In what part of the country did you live the longest before age 16? Please fill in one oval.
- ◯ New England (ME, NH, VT, MA, CT, RI)
- ◯ Middle Atlantic (NJ, NY, PA)
- ◯ South Atlantic (DE, MD, VA, WV, NC, SC, GA, FL, DC)
- ◯ North Central (OH, IN, IL, MI, WI, MN, IA, MO, ND, SD, NE, KS)
- ◯ South Central (KY, TN, AL, MS, AR, LA, OK, TX)
- ◯ Mountain (ID, WY, CO, MT, AZ, NM, UT, NV)
- ◯ Pacific (WA, OR, CA, AK, HI)
- ◯ Other (please specify):_____

11. How would you describe your level of activity, during the training exercise?
- ◯ Heavy daily physical activity
- ◯ Moderate daily physical activity
- ◯ Light daily physical activity
- ◯ Mixed activity, day to day

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9 S

0 1 2 3 4 5 6 7 8 9 A

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H
1 2 3 4 5 6 7 8 9 10 11

W
0 1 2 3 4 5 6 7 8 9

12. Please use the following scale to indicate how much you like or dislike each of the items in the General Purpose Survival Packet by filling in the oval below the number that best describes your opinion of each item. For example, if you did not try an item, fill in the oval under "0" or, if you liked it very much, fill in the oval under "8".

DIDN'T TRY	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9

	0	1	2	3	4	5	6	7	8	9
Granola/Oatmeal Bar	○	○	○	○	○	○	○	○	○	○
Cornflake Bar	○	○	○	○	○	○	○	○	○	○
Cornflake & Rice Bar	○	○	○	○	○	○	○	○	○	○
Coffee	○	○	○	○	○	○	○	○	○	○
Sugar	○	○	○	○	○	○	○	○	○	○
Soup and Gravy Base	○	○	○	○	○	○	○	○	○	○

13. Do you think that any items should be DROPPED from the General Purpose Survival Packet?

○ YES ○ NO

If YES, please list item(s) and state why you think the item(s) should be dropped._____

_____

_____

_____

14. Do you think that any items should be ADDED to the General Purpose Survival Packet?

○ YES ○ NO

If YES, please list the item(s). Please be realistic. _____

_____

_____

_____

15. Overall, how acceptable was the General Purpose Survival Packet? Fill in one oval.

EXTREMELY UNACCEPTABLE	VERY UNACCEPTABLE	MODERATELY UNACCEPTABLE	SLIGHTLY UNACCEPTABLE	NEUTRAL	SLIGHTLY ACCEPTABLE	MODERATELY ACCEPTABLE	VERY ACCEPTABLE	EXTREMELY ACCEPTABLE
○	○	○	○	○	○	○	○	○

16. How often did you throw away or trade any of the GP bars?

	NEVER	ONE TIME	TWO TIMES	THREE TIMES	FOUR TIMES	MORE THAN FOUR TIMES
Threw away	○	○	○	○	○	○
Traded	○	○	○	○	○	○

17. Were the instructions for preparing the GP helpful? Fill in one oval.

NOT AT ALL HELPFUL	SLIGHTLY HELPFUL	SOMEWHAT HELPFUL	MODERATELY HELPFUL	VERY HELPFUL	EXTREMELY HELPFUL
○	○	○	○	○	○

18. Please rate how satisfied or dissastisfied you were with each of the following aspects of the GP. Fill in one oval for each aspect.

EXTREMELY DISSATISFIED	VERY	MODERATELY	SOMEWHAT DISSATISFIED	NEUTRAL	SOMEWHAT SATISFIED	MODERATELY	VERY	EXTREMELY SATISFIED
1	2	3	4	5	6	7	8	9

	1	2	3	4	5	6	7	8	9
How easy the food is to prepare	○	○	○	○	○	○	○	○	○
How the food tastes	○	○	○	○	○	○	○	○	○
How the food looks	○	○	○	○	○	○	○	○	○
How much food there is in one box	○	○	○	○	○	○	○	○	○
How much variety there is in one box	○	○	○	○	○	○	○	○	○
How easy the GP is to pack and carry	○	○	○	○	○	○	○	○	○

19. How many GP Bars did you usually eat a day?

- ○ Less than One
- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five
- ○ Six
- ○ Seven
- ○ Eight
- ○ Nine
- ○ Ten
- ○ More than Ten

20. How many DAYS did your supply of GP bars last?

- ○ Less than One
- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five

21. When did you usually eat the GP? Fill in one oval.

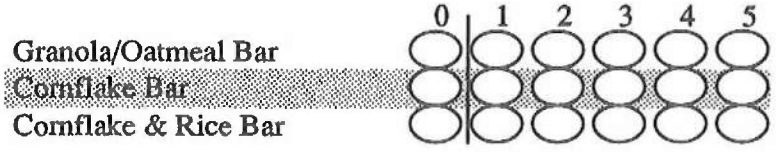
- ○ 1. At specified meal times imposed by command.
- ○ 2. At specified meal times by your own choice.
- ○ 3. Throughout the day, as time permitted.
- ○ 4. Both 1 and 3.
- ○ 5. Both 2 and 3.

22. How often were you HUNGRY during the exercise? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
◯	◯	◯	◯	◯	◯

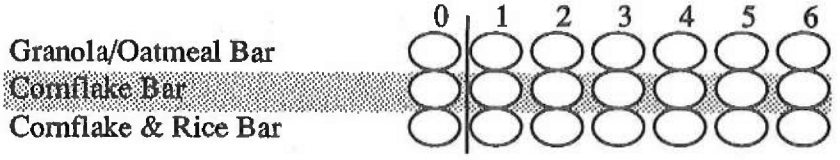
23. What did you think of the TEXTURE of the food? Was it too hard, too soft or just right? Please fill in one oval for each food.

DIDN'T TRY	TOO SOFT	SOMEWHAT SOFT	JUST RIGHT	SOMEWHAT HARD	TOO HARD
0	1	2	3	4	5

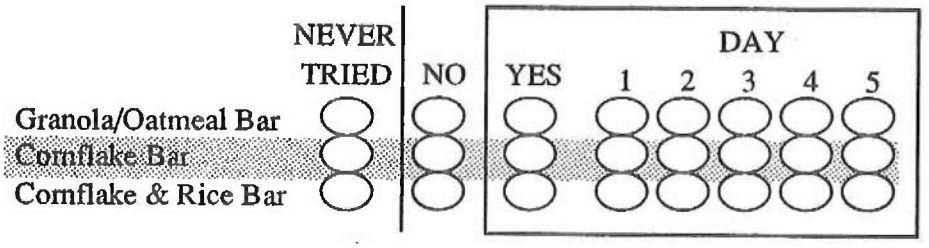


24. Did you have problems with losing food because it was very crumbly and fell out of the package or out of your mouth while you were eating? Please fill in one oval for each food.

DIDN'T TRY	NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
0	1	2	3	4	5	6



25. Did you get tired of chewing the ration? Fill in one oval for each ration. If you answered "YES" for any part of the ration, please indicate which day you first became tired of chewing.



26. Did your gums get sore as a result of chewing the GP? If you answered "YES", please indicate which day your gums first became sore.

NO	YES	DAY 1	2	3	4	5
○	○	○	○	○	○	○

27. For what reasons did you NOT eat enough? Fill in all ovals that apply. If you ALWAYS ate enough while eating the GP, fill in reason "n" only.

- ○ a. Disliked the food in the General Purpose Survival Packet
- ○ b. Not enough food provided in the General Purpose Survival Packet
- ○ c. Got tired of chewing the General Purpose Survival Packet
- ○ d. Gums were too sore to eat the General Purpose Survival Packet
- ○ e. Not enough time to eat the General Purpose Survival Packet
- ○ f. Not enough water to prepare the General Purpose Survival Packet
- ○ g. Got bored with the food in the GP-not enough variety
- ○ h. GP bars were broken into crumbs in package
- ○ i. GP bars broke into crumbs while I was eating
- ○ j. General Purpose Survival Packet packaging was damaged
- ○ k. Tried to avoid having to go to the bathroom
- ○ l. Did not feel hungry
- ○ m. Other: _____
- ○ n. Always ate enough while using the GP

28. If you chose more than one reason for not eating enough in question #27, please fill in the oval under the letter of the most frequent reason for not eating enough.

a	b	c	d	e	f	g	h	i	j	k	l	m
○	○	○	○	○	○	○	○	○	○	○	○	○

29. How often were you THIRSTY during the field exercise? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
○	○	○	○	○	○

30. How did you obtain water? Fill in the oval next to ALL the reasons that apply. If you choose more than one reason, please mark an "X" next to the most frequent way you obtained water.

- ○ a. Melted snow or ice
- ○ b. From a spring
- ○ c. From a stream
- ○ d. From a lake or pond
- ○ e. 5 gallon cans
- ○ f. Water buffalo
- ○ g. Other:_____

31. Did you purify your water? ○ YES ○ NO
If YES, how did you purify it? Please explain.

32. How easy or difficult was it for you to obtain water? Fill in one oval.

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEUTRAL	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
○	○	○	○	○	○	○	○	○

33. How often were you able to get enough water to prepare foods and beverages? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
○	○	○	○	○	○

34. How often did you add water to the General Purpose Survival Packet foods and beverages? Fill in the oval under the number that best expresses your answer next to each food or beverage

DIDN'T TRY	NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
0	1	2	3	4	5	6

	0	1	2	3	4	5	6
Granola/Oatmeal Bar	○	○	○	○	○	○	○
Cornflake Bar	○	○	○	○	○	○	○
Coffee	○	○	○	○	○	○	○
Soup and Gravy Base	○	○	○	○	○	○	○

35. For what reasons did you NOT drink enough during the exercise? Fill in the oval next to ALL the reasons that apply. If you ALWAYS drank enough while eating the GP, fill in reason "l" only.

- ○ a. Too much trouble to get water
- ○ b. Water source was too far from site
- ○ c. Not enough water available
- ○ d. Not enough beverages (coffee) in General Purpose Survival Packet
- ○ e. No way/too difficult to heat water to make coffee
- ○ f. General Purpose Survival Packet items were too dry
- ○ g. Water buffalo/water supply was empty
- ○ h. Tried to avoid having to go to the bathroom
- ○ i. Did not feel thirsty
- ○ j. Did not feel I needed more water
- ○ k. Other: _____
- ○ l. Always drank enough during this exercise

36. If you chose more than one reason for not drinking enough in question #35, please fill in the oval under the letter of the most frequent reason for not drinking enough.

a	b	c	d	e	f	g	h	i	j	k
○	○	○	○	○	○	○	○	○	○	○

37. During this exercise, how did you heat water to prepare the GP? Please fill in the oval next to all that apply. If you used more than one heating method, please place an "X" next to the BEST method you used.

- ◯ Did not heat water
- ◯ Canteen cup and heat tabs
- ◯ Canteen cup stand, canteen cup and heat tabs
- ◯ MRE heater pads (Zestotherm)
- ◯ Mounted vehicle heater
- ◯ Heated water on engine block of vehicle
- ◯ Squad stove
- ◯ Yukon stove
- ◯ Optimus ranger stove
- ◯ Sterno
- ◯ Other (please specify):_____

38. How often did you heat water to prepare the GP?

- ◯ Never
- ◯ Once, while eating the GP
- ◯ Several times, while eating the GP (please specify:_____)
- ◯ Everyday

39. Overall, how easy or difficult was the General Purpose Survival Packet to use? Fill in one oval.

EXTREMELY DIFFICULT	VERY DIFFICULT	MODERATELY DIFFICULT	SLIGHTLY DIFFICULT	NEUTRAL	SLIGHTLY EASY	MODERATELY EASY	VERY EASY	EXTREMELY EASY
◯	◯	◯	◯	◯	◯	◯	◯	◯

40. How important do you think it is to include a canteen cup, or some other device like it, in the GP?

NOT AT ALL	SLIGHTLY IMPORTANT	MODERATELY IMPORTANT	VERY IMPORTANT	EXTREMELY IMPORTANT
◯	◯	◯	◯	◯

41. Please rate how EASY or DIFFICULT you found each of the following aspects of preparing the General Purpose Survival Packet. Fill in one oval for each.

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY		SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
1	2	3	4	NEUTRAL 5	6	7	8	9

	1	2	3	4	5	6	7	8	9
Opening the outer box	◯	◯	◯	◯	◯	◯	◯	◯	◯
Opening an individual bar	◯	◯	◯	◯	◯	◯	◯	◯	◯
Keeping coffee, soup and gravy base and sugar packets dry	◯	◯	◯	◯	◯	◯	◯	◯	◯
Obtaining enough water to prepare foods or drinks	◯	◯	◯	◯	◯	◯	◯	◯	◯
Mixing the right amount of water with the dry ration items	◯	◯	◯	◯	◯	◯	◯	◯	◯
Crumbling the ration before adding water	◯	◯	◯	◯	◯	◯	◯	◯	◯
Avoiding spilling package contents	◯	◯	◯	◯	◯	◯	◯	◯	◯
Other: _____	◯	◯	◯	◯	◯	◯	◯	◯	◯

42. While eating the General Purpose Survival Packet, did you eat any other food besides what was provided in the ration? ◯ YES ◯ NO

If YES, please list the general food items, about how often you ate them and about how much you ate of them.

FOOD	HOW OFTEN	HOW MUCH

43. Were there any ESSENTIAL pieces of equipment that you needed to prepare the GP or forage for food that were not provided with the ration?

44. What do you like most about the General Purpose Survival Packet?

45. What do you like least about the General Purpose Survival Packet?

46. Do you have any other comments about the General Purpose Survival Packet?

47. During this study, did you experience LESS, ABOUT THE SAME or MORE cramps, abdominal discomfort and/or gas than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

CRAMPS, ABDOMINAL DISCOMFORT, AND/OR GAS

48. During this study, did you experience LESS, ABOUT THE SAME or MORE nausea or vomiting than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

NAUSEA OR VOMITING

49. During this study, did you experience LESS, ABOUT THE SAME or MORE diarrhea than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

DIARRHEA

50. During this study, did you experience LESS, ABOUT THE SAME or MORE constipation than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

CONSTIPATION

51. During this study, did you experience LESS, ABOUT THE SAME or MORE heart burn/acid stomach than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

HEART BURN/ ACID STOMACH

52. During this study, was your appetite LESS, ABOUT THE SAME or GREATER than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ GREATER

APPETITE

53. Of the symptoms listed below, please indicate how often during an "average" week you experience each one. If you normally don't experience a symptom, please fill in the oval under "0". Please fill in one oval for each symptom.

	TIMES PER WEEK			
	0	1-2	3-4	>5
POOR APPETITE	◯	◯	◯	◯
CRAMPS, ABDOMINAL DISCOMFORT, GAS	◯	◯	◯	◯
NAUSEA/VOMITING	◯	◯	◯	◯
DIARRHEA	◯	◯	◯	◯
CONSTIPATION	◯	◯	◯	◯
HEARTBURN, ACID STOMACH	◯	◯	◯	◯

THANK YOU!!!!!!

FINAL QUESTIONNAIRE

We would like to ask you some questions about the New Generation Survival Ration (NGSR) which you ate during your field training exercise. Your opinions will be very important in determining any changes that will be made in the ration. Your answers will be kept confidential. Please answer honestly and thoughtfully. Please use a number two pencil to fill in the ovals. Thank you.

Please indicate your Social Security number. (Last four digits only)

_____

1. What is your rank?

	1	2	3	4	5	6	7	8	9
E	◯	◯	◯	◯	◯	◯	◯	◯	◯
O	◯	◯	◯	◯	◯	◯	◯	◯	◯
WO	◯	◯	◯	◯					

2. How long have you been in the Armed Services? _____YEARS_____MONTHS

3. Have you ever had any survival training prior to thIs exercise? ◯ YES ◯ NO

4. What is your weight? _____LBS

5. What is your height? _____FT _____IN

6. What is your sex?
- ◯ Male
- ◯ Female

7. What is your age? _____

8. Are you currently trying to: ◯ lose weight? ◯ gain weight? ◯ neither?

9. Which ethnic group do you belong to? Please fill in one oval.
- ◯ American Indian/Alaskan Native
- ◯ Asian/Pacific Islander
- ◯ Black/African
- ◯ Hispanic
- ◯ White/Caucasian, not of Hispanic origin
- ◯ Other (please specify):_____

PLEASE USE A #2 PENCIL

Proper Mark

10. In what part of the country did you live the longest before age 16? Please fill in one oval.
- ◯ New England (ME, NH, VT, MA, CT, RI)
- ◯ Middle Atlantic (NJ, NY, PA)
- ◯ South Atlantic (DE, MD, VA, WV, NC, SC, GA, FL, DC)
- ◯ North Central (OH, IN, IL, MI, WI, MN, IA, MO, ND, SD, NE, KS)
- ◯ South Central (KY, TN, AL, MS, AR, LA, OK, TX)
- ◯ Mountain (ID, WY, CO, MT, AZ, NM, UT, NV)
- ◯ Pacific (WA, OR, CA, AK, HI)
- ◯ Other (please specify):_____

11. How would you describe your level of activity, during the training exercise?
- ◯ Heavy daily physical activity
- ◯ Moderate daily physical activity
- ◯ Light daily physical activity
- ◯ Mixed activity, day to day

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

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0 1 2 3 4 5 6 7 8 9

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DO NOT WRITE IN THIS AREA

H

1 2 3 4 5 6 7 8 9 10 11

W

0 1 2 3 4 5 6 7 8 9

12. Please use the following scale to indicate how much you like or dislike each of the items in the New Generation Survival Ration by filling in the oval below the number that best describes your opinion of each item. For example, if you did not try an item, fill in the oval under "0" or, if you liked it very much, fill in the oval under "8".

DIDN'T TRY	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9

	0	1	2	3	4	5	6	7	8	9
Cornflake Bar	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Shortbread	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Candy	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Granola Bar	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Chocolate Chip Bar	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Coffee	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Sugar	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Soup and Gravy Base	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

13. Do you think that any items should be DROPPED from the New Generation Survival Ration?

◯ YES ◯ NO

If YES, please list item(s) and state why you think the item(s) should be dropped. _____

_____

_____

_____

14. Do you think that any items should be ADDED to the New Generation Survival Ration?

◯ YES ◯ NO

If YES, please list the item(s). Please be realistic. _____

_____

_____

_____

15. Overall, how acceptable was the New Generation Survival Ration? Fill in one oval.

EXTREMELY UNACCEPTABLE	VERY	MODERATELY	SLIGHTLY UNACCEPTABLE	NEUTRAL	SLIGHTLY ACCEPTABLE	MODERATELY	VERY	EXTREMELY ACCEPTABLE
◯	◯	◯	◯	◯	◯	◯	◯	◯

16. How often did you throw away or trade any of the NGSR bars?

	NEVER	ONE TIME	TWO TIMES	THREE TIMES	FOUR TIMES	MORE THAN FOUR TIMES
Threw away	◯	◯	◯	◯	◯	◯
Traded	◯	◯	◯	◯	◯	◯

17. Were the instructions for preparing the NGSR helpful? Fill in one oval.

NOT AT ALL HELPFUL	SLIGHTLY HELPFUL	SOMEWHAT HELPFUL	MODERATELY HELPFUL	VERY HELPFUL	EXTREMELY HELPFUL
○	○	○	○	○	○

18. Please rate how satisfied or dissastisfied you were with each of the following aspects of the NGSR. Fill in one oval for each aspect.

EXTREMELY DISSATISFIED	VERY	MODERATELY	SOMEWHAT DISSATISFIED	NEUTRAL	SOMEWHAT SATISFIED	MODERATELY	VERY	EXTREMELY SATISFIED
1	2	3	4	5	6	7	8	9

	1	2	3	4	5	6	7	8	9
How easy the food is to prepare	○	○	○	○	○	○	○	○	○
How the food tastes	○	○	○	○	○	○	○	○	○
How the food looks	○	○	○	○	○	○	○	○	○
How much food there is in one box	○	○	○	○	○	○	○	○	○
How much variety there is in one box	○	○	○	○	○	○	○	○	○
How easy the NGSR is to pack and carry	○	○	○	○	○	○	○	○	○

19. How many NGSR Bars did you usually eat a day?

- ○ Less than One
- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five
- ○ Six
- ○ Seven
- ○ Eight
- ○ Nine
- ○ Ten
- ○ More than Ten

20. How many DAYS did your supply of NGSR bars last?

- ○ Less than One
- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five

21. When did you usually eat the NGSR? Fill in one oval.

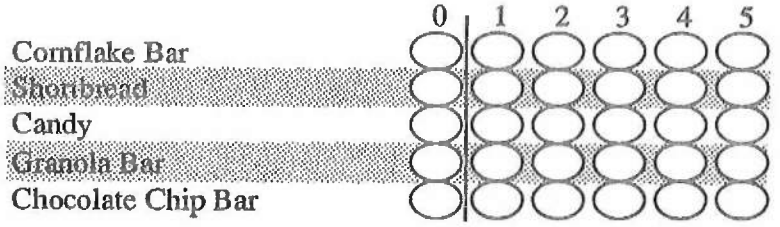
- ○ 1. At specified meal times imposed by command.
- ○ 2. At specified meal times by your own choice.
- ○ 3. Throughout the day, as time permitted.
- ○ 4. Both 1 and 3.
- ○ 5. Both 2 and 3.

22. How often were you HUNGRY during the exercise? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
◯	◯	◯	◯	◯	◯

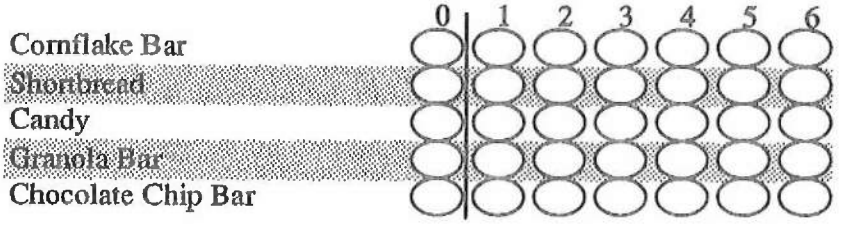
23. What did you think of the TEXTURE of the food? Was it too hard, too soft or just right? Please fill in one oval for each food.

DIDN'T TRY	TOO SOFT	SOMEWHAT SOFT	JUST RIGHT	SOMEWHAT HARD	TOO HARD
0	1	2	3	4	5

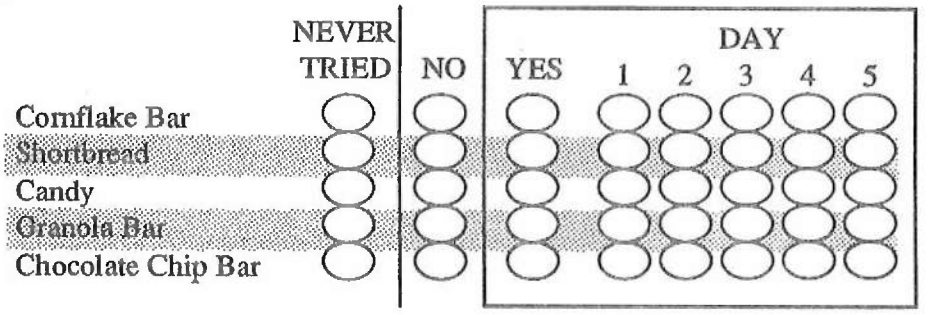


24. Did you have problems with losing food because it was very crumbly and fell out of the package or out of your mouth while you were eating? Please fill in one oval for each food.

DIDN'T TRY	NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
0	1	2	3	4	5	6



25. Did you get tired of chewing the ration? Fill in one oval for each ration. If you answered "YES" for any part of the ration, please indicate which day you first became tired of chewing.



26. Did your gums get sore as a result of chewing the NGSR? If you answered "YES", please indicate which day your gums first became sore.

NO	YES	DAY 1	2	3	4	5
○	○	○	○	○	○	○

27. For what reasons did you NOT eat enough? Fill in all ovals that apply. If you ALWAYS ate enough while eating the NGSR, fill in reason "n" only.

- ○ a. Disliked the food in the New Generation Survival Ration
- ○ b. Not enough food provided in the New Generation Survival Ration
- ○ c. Got tired of chewing the New Generation Survival Ration
- ○ d. Gums were too sore to eat the New Genration Survival Ration
- ○ e. Not enough time to eat the New Generation Survival Ration
- ○ f. Not enough water to prepare the New Generation Survival Ration
- ○ g. Got bored with the food in the NGSR-not enough variety
- ○ h. NGSR bars were broken into crumbs in package
- ○ i. NGSR bars broke into crumbs while I was eating
- ○ j. New Generation Survival Ration packaging was damaged
- ○ k. Tried to avoid having to go to the bathroom
- ○ l. Did not feel hungry
- ○ m. Other: _____
- ○ n. Always ate enough while using the NGSR

28. If you chose more than one reason for not eating enough in question #27, please fill in the oval under the letter of the most frequent reason for not eating enough.

a	b	c	d	e	f	g	h	i	j	k	l	m
○	○	○	○	○	○	○	○	○	○	○	○	○

29. How often were you THIRSTY during the field exercise? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
○	○	○	○	○	○

30. How did you obtain water? Fill in the oval next to ALL the reasons that apply. If you choose more than one reason, please mark an "X" next to the most frequent way you obtained water.

- ○ a. Melted snow or ice
- ○ b. From a spring
- ○ c. From a stream
- ○ d. From a lake or pond
- ○ e. 5 gallon cans
- ○ f. Water buffalo
- ○ g. Other:_____

31. Did you purify your water? ○ YES ○ NO
If YES, how did you purify it? Please explain.

32. How easy or difficult was it for you to obtain water? Fill in one oval.

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEUTRAL	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
◯	◯	◯	◯	◯	◯	◯	◯	◯

33. How often were you able to get enough water to prepare foods and beverages? Fill in one oval.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
◯	◯	◯	◯	◯	◯

34. How often did you add water to the New Generation Survival Ration foods and beverages? Fill in the oval under the number that best expresses your answer next to each food or beverage

DIDN'T TRY	NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	ALMOST ALWAYS	ALWAYS
0	1	2	3	4	5	6

	0	1	2	3	4	5	6
Granola Bar	◯	◯	◯	◯	◯	◯	◯
Cornflake Bar	◯	◯	◯	◯	◯	◯	◯
Coffee	◯	◯	◯	◯	◯	◯	◯
Soup and Gravy Base	◯	◯	◯	◯	◯	◯	◯

35. For what reasons did you NOT drink enough during the exercise? Fill in the oval next to ALL the reasons that apply. If you ALWAYS drank enough while eating the NGSR, fill in reason "l" only.

- ◯ a. Too much trouble to get water
- ◯ b. Water source was too far from site
- ◯ c. Not enough water available
- ◯ d. Not enough beverages (coffee) in New Generation Survial Ration
- ◯ e. No way/too difficult to heat water to make coffee
- ◯ f. New Generation Survival Ration items were too dry
- ◯ g. Water buffalo/water supply was empty
- ◯ h. Tried to avoid having to go to the bathroom
- ◯ i. Did not feel thirsty
- ◯ j. Did not feel I needed more water
- ◯ k. Other: _____
- ◯ l. Always drank enough during this exercise

36. If you chose more than one reason for not drinking enough in question #35, please fill in the oval under the letter of the most frequent reason for not drinking enough.

a	b	c	d	e	f	g	h	i	j	k
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

37. During this exercise, how did you heat water to prepare the NGSR? Please fill in the oval next to all that apply. If you used more than one heating method, please place an "X" next to the BEST method you used.

- ◯ Did not heat water
- ◯ Canteen cup and heat tabs
- ◯ Canteen cup stand, canteen cup and heat tabs
- ◯ MRE heater pads (Zestotherm)
- ◯ Mounted vehicle heater
- ◯ Heated water on engine block of vehicle
- ◯ Squad stove
- ◯ Yukon stove
- ◯ Optimus ranger stove
- ◯ Sterno
- ◯ Other (please specify):_____

38. How often did you heat water to prepare the NGSR?

- ◯ Never
- ◯ Once, while eating the NGSR
- ◯ Several times, while eating the NGSR (please specify:_____)
- ◯ Everyday

39. Overall, how easy or difficult was the New Generation Survival Ration to use? Fill in one oval.

EXTREMELY DIFFICULT	VERY DIFFICULT	MODERATELY DIFFICULT	SLIGHTLY DIFFICULT	NEUTRAL	SLIGHTLY EASY	MODERATELY EASY	VERY EASY	EXTREMELY EASY
◯	◯	◯	◯	◯	◯	◯	◯	◯

40. How important do you think it is to include a canteen cup, or some other device like it, in the NGSR?

NOT AT ALL	SLIGHTLY IMPORTANT	MODERATELY IMPORTANT	VERY IMPORTANT	EXTREMELY IMPORTANT
◯	◯	◯	◯	◯

41. Please rate how EASY or DIFFICULT you found each of the following aspects of preparing the New Generation Survival Ration. Fill in one oval for each.

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEUTRAL	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
1	2	3	4	5	6	7	8	9

	1	2	3	4	5	6	7	8	9
Opening the outer box	◯	◯	◯	◯	◯	◯	◯	◯	◯
Opening an individual bar	◯	◯	◯	◯	◯	◯	◯	◯	◯
Keeping coffee, soup and gravy base and sugar packets dry	◯	◯	◯	◯	◯	◯	◯	◯	◯
Obtaining enough water to prepare foods or drinks	◯	◯	◯	◯	◯	◯	◯	◯	◯
Mixing the right amount of water with the dry ration items	◯	◯	◯	◯	◯	◯	◯	◯	◯
Crumbling the ration before adding water	◯	◯	◯	◯	◯	◯	◯	◯	◯
Avoiding spilling package contents	◯	◯	◯	◯	◯	◯	◯	◯	◯
Other: _____	◯	◯	◯	◯	◯	◯	◯	◯	◯

42. While eating the New Generation Survival Ration, did you eat any other food besides what was provided in the ration? ◯ YES ◯ NO

If YES, please list the general food items, about how often you ate them and about how much you ate of them.

FOOD	HOW OFTEN	HOW MUCH

43. Were there any ESSENTIAL pieces of equipment that you needed to prepare the NGSR or forage for food that were not provided with the ration?

44. What do you like most about the New Generation Survival Ration?

45. What do you like least about the New Generation Survival Ration?

46. Do you have any other comments about the New Generation Survival Ration?

47. During this study, did you experience LESS, ABOUT THE SAME or MORE cramps, abdominal discomfort and/or gas than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

CRAMPS, ABDOMINAL DISCOMFORT, AND/OR GAS

48. During this study, did you experience LESS, ABOUT THE SAME or MORE nausea or vomiting than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

NAUSEA OR VOMITING

49. During this study, did you experience LESS, ABOUT THE SAME or MORE diarrhea than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

DIARRHEA

50. During this study, did you experience LESS, ABOUT THE SAME or MORE constipation than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

CONSTIPATION

51. During this study, did you experience LESS, ABOUT THE SAME or MORE heart burn/acid stomach than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ MORE

HEART BURN/ ACID STOMACH

52. During this study, was your appetite LESS, ABOUT THE SAME or GREATER than is usual for you? Please fill in one oval.

- ◯ LESS
- ◯ ABOUT THE SAME
- ◯ GREATER

APPETITE

53. Of the symptoms listed below, please indicate how often during an "average" week you experience each one. If you normally don't experience a symptom, please fill in the oval under "0". Please fill in one oval for each symptom.

	TIMES PER WEEK			
	0	1-2	3-4	>5
POOR APPETITE	◯	◯	◯	◯
CRAMPS, ABDOMINAL DISCOMFORT, GAS	◯	◯	◯	◯
NAUSEA/VOMITING	◯	◯	◯	◯
DIARRHEA	◯	◯	◯	◯
CONSTIPATION	◯	◯	◯	◯
HEARTBURN, ACID STOMACH	◯	◯	◯	◯

THANK YOU!!!!!!

APPENDIX F
LOGICAL REASONING AND WILKINSON PERFORMANCE TESTS

METHODS

Psychomotor performance testing was conducted utilizing Paravant RHC-88 computers borrowed from U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL. The RHC-88 is a notebook-sized (9.5" x 6.3" x 2.5"), hand-held computer, weighing under five pounds, that is MS-DOS-based and IBM compatible. It is ruggedized and therefore is able to withstand harsh field conditions such as dust, mud, vibrations, rain and impact shock (1). For this study, the 12-minute performance test consisted of two tasks, the Logical Reasoning and the Wilkinson.

The Logical Reasoning task (2) is a reliable test of higher mental processes and has been used extensively to investigate the effects of new environment on human performance (3).

For this task, two letters were presented with a sentence describing the letters. For example:

A B

A is not preceded by B

The subjects had to decide whether the statement correctly described the order of the two letters and hit the corresponding key (S, same or D, different). In this example, the correct response would be "S" for same.

The Wilkinson test presented subjects with four boxes on the screen, one shaded and the other three as box outlines. As the shaded box changed location each subject was required to hit a key on the keypad corresponding to the new location of the shaded box as quickly as possible. Relative key positions were the same on the keyboard as on the display.

The programs were set up identically on each computer so that each subject would get the same trials presented in the same order. However, the tests were different from session to session.

The tests were set up for a three minute "practice" session, immediately followed by a three-minute "test" session. The three-minute practice session, shown to be effective in previous administrations (1), enabled the subjects to stabilize their performance before the "test" session. The performance test battery was presented three times to the two sub-groups of subjects. The

practice round was presented during the pre-test measurements, the pre-test round was presented just prior to the subjects exiting the bus to go into the field and the posttest round was presented at the final point before their departure from the field. Because of the students' training schedule, it was not possible to administer a mid-test session.

Before each round, the students were instructed to respond using one finger of their dominant hand and to hold the computer with their other hand. Also, regardless of whether they chose to sit or stand they were instructed to do the same for each battery and to work as quickly and accurately as possible.

RESULTS

Due to the environmental conditions under which testing occurred, equipment problems and limited testing opportunities, the data collected from the Logical Reasoning and Wilkinson tasks were felt to be unreliable. Also the test schedule did not permit the subjects to bring their pre-test performance to asymptote.

No significant differences were found in performance, based on the data that were collected from each task, either between the two groups or from the pre-test session to the posttest session (Tables 21-22). Due to the training regimen, it was not possible to create a "adequately fed" (consuming MREs, for example) control group for comparison.

Table 21. Reaction time for a correct response (seconds)

Logical Reasoning	Pre	Post
GP	4.8±1.8	6.5±3.1
GP-I	5.1±1.3	6.3±1.8
Wilkinson	**Pre**	**Post**
GP	0.63±0.11	0.66±0.12
GP-I	0.61±0.08	0.64±0.11

Table 22. Accuracy (percent of correct responses)

Logical Reasoning	Pre	Post
GP	83±16	89±15
GP-I	89±7	90±10
Wilkinson	**Pre**	**Post**
GP	97±6	99±1
GP-I	98±3	98±2

DISCUSSION AND CONCLUSIONS

The field conditions and training regimen of the study were not conducive to a satisfactorily controlled setting for psychomotor performance testing and did not allow inclusion of a "adequately fed" (subsisting on MREs, for example) control group. As a result, no meaningful conclusions can be derived from the data regarding the effects of the GP and GP-I on psychomotor performance. The very nature of survival training, which allows for only limited contact with the students and restricted issue of rations, makes it difficult to achieve control and repeat administration of batteries as necessary for adequate performance testing.

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APPENDIX G
PLANS AND RECOMMENDATIONS FOR THE GP-I

A Joint Working Group (JWG) meeting comprised of Air Force, Army, Navy and Marine representatives who will use the Food Packet Survival, General Purpose, Improved (GP-I), was held in June 1992 to discuss and finalize the contents and packaging system of the GP-I. Presently, the GP-I contains compressed bars, individually packaged in a water-proof trilaminate pouch and contained in a paperboard box that will have an exterior water-resistent coating. The paperboard box used in this test did not have this coating, and therefore, disintegrated when wet. The General Purpose Survival Packet (GP) contains compressed bars, individually packaged in cellophane and contained in an aluminum can. Questionnaires from the field test indicated that the test subjects wanted some type of utensil in which to collect and heat water. While the GP is contained in an aluminum can, this can was not designed to be heated and it has a non-toxic, food grade coating needed for its production. When heated the coating produces unsightly white flakes that float in water. Furthermore, if the can is heated without liquid over a direct flame, this substance may be toxic. For this reason, the aircrew members are instructed not to use the can for heating water. At the JWG, all principles agreed to adopt the present GP-I with a water resistent paperboard box, and each bar individually wrapped in trilaminate material as the primary packaging. The military services will provide a canteen cup or other heating utensil for training exercises and with aircraft flight kits.

Another concern of some of the test subjects was the additional trash generated by the GP-I trilaminate pouches that could not be burned and had to be carried out. On the other hand, some of the subjects liked the ability to eat a portion of a bar and re-wrap it in it's pouch for later consumption. Since the aluminum can is no longer a viable alternative for the GP-I, the trilaminate pouch is necessary to provide protection for each individual bar and to meet the five year shelf life requirement. These pouches (six to a ration) readily flatten out after the bar is eaten, and can easily fit into a battle dress uniform pocket for later disposal.

Also, the test subjects were not aware that they could rehydrate some of the bars in both of the rations. While instructions for rehydration are not provided on the GP container, they are provided on the GP-I container. Unfortunately, due to the extremely rainy weather conditions during both exercises, the GP-I paperboard box without a water-resistent coating, readily disintegrated. The new water-resistent coating required on all GP-Is should eliminate this problem. Also, rehydration instructions will be provided on each applicable bar package.

In regards to the concern about coffee in the rations, it was determined by USARIEM and Natick that one packet per day would not produce excessive diuresis. However, it has become clear that many of the younger military personnel do not drink coffee and prefer to have some

other type of beverage. Natick has taken this into consideration and will replace the coffee with lemon tea that has been found to be highly acceptable in the Ration, Cold Weather. While the tea does contain some caffeine and can be a diuretic, it is not considered a problem when only one packet per day is consumed. The reason that another dehydrated beverage, such as the beverage base for the Meal, Ready-to-Eat ration is not used, is that the volume of the beverage base is considerably larger than the volume of the lemon tea, and it will not fit within the volume constraints of the packet.

The request for a salty item, fruit, meat and a salt packet in the GP-I has been taken into consideration. However, the nutritional content of the ration has been approved by the Committee on Military Nutrition Research (1) and must be strictly observed in a survival packet. The Committee has determined that protein and sodium must be restricted to conserve body water and prevent ketosis. Therefore, the inclusion of meat, salty snack item or salt packet may cause excessive body water loss and is not a viable option. The soup and gravy base, which was found to be highly desirable in these tests, provides the limited amount of sodium required. A dried fruit product would provide extra carbohydrate and little or no protein which is desirable in this type of ration. Unfortunately, dried fruit, which has a longer shelf life than other types of fruit, does not have the shelf stability which is required in the GP-I. Also, the volume of thermostabilized fruits is above the limit for the GP-I.

A test of the GP-I with a "adequately fed" (subsisting on MREs) control group is planned for July 1992 in the climatic chambers at Natick. The purpose of the test is to determine the psychological and physiological effects of consuming the GP-I for five consecutive days in a controlled environment. The GP-I test ration will include lemon tea in place of coffee and an all carbohydrate wintergreen bar in place of the Charms candy.

The GP-I will be type classified in October 1992 and will be available for procurement by the military services in the spring of 1993.

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